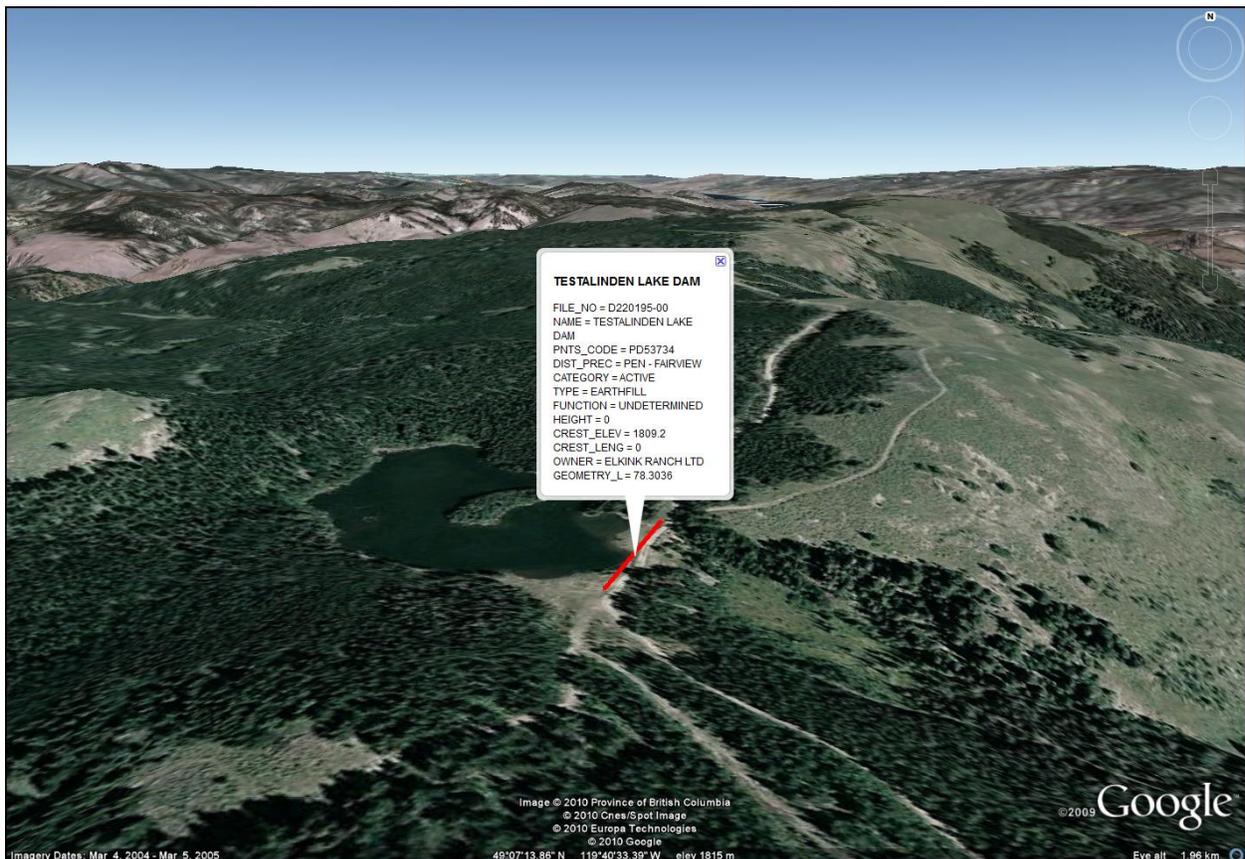


Response to Recommendations Contained in the Report: “Review of the Testalinden Dam Failure” (July 2010)



Ministry of Environment

October 2010

FORWARD

This response, the rapid dam assessment and the other steps being taken to improve dam safety in British Columbia could only be accomplished through the dedicated work of the Dam Safety Officers, program staff and our partners, including Emergency Management BC, the Ministry of Forests and Range, the Ministry of Energy, Mines and Petroleum Resources and local governments. Going forward, the Ministry of Environment will have a greater on-the-ground presence to ensure dam safety. These staff will assist us in our continued work to ensure public safety and deliver on the Recommendations of the Deputy Solicitor General.

Doug Konkin
Deputy Minister
Ministry of Environment
October 14, 2010

Cover Image: Testalinden Dam, before the dam failure, as available through Google Earth with geo-referenced dam information. This information is available on Google Earth for all dams in British Columbia: [BC Dams](#).
Note: To run the BC Dam Google Earth program, you must save the file to your computer. You may open the file from the dialogue box which will appear once the download is complete. The latest version of Google Earth is required.

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BACKGROUND

On June 13, 2010, a privately-owned earthen dam on a man-made reservoir on Testalinden Creek failed, causing a debris and mud torrent that severely impacted a number of homes and an agricultural area eight kilometres south of Oliver, British Columbia.

As a result of this incident, Solicitor General Michael de Jong launched a review to both identify the circumstances leading up to the dam failure and to produce recommendations to help prevent these types of dam failures from re-occurring. David Morhart, Deputy Solicitor General completed a *Review of the Testalinden Dam Failure* and included 12 recommendations for improving dam safety in BC.

Immediately following the Testalinden dam breach, staff from the Ministry of Environment (the Ministry) conducted a review of the Provincial Dam Safety Program and initiated a Rapid Dam Assessment (RDA) for the majority of dams in the province. This assessment was undertaken to determine if there were any other dams at risk of imminent failure and create an updated inventory of dams in the province. In conjunction with this review the Ministry undertook other work to deliver on the remaining Recommendations made by the Deputy Solicitor General.

This report outlines the results of our dam assessments and the status of the work on the other recommendations. The response includes reports from Emergency Management BC on progress with Recommendations # 4 and #6, for which they are responsible as well as input from other Ministries where appropriate. This report is a snap-shot in time. It outlines the progress we have made and ongoing action to deliver on the recommendations and improve dam safety in British Columbia.

SUMMARY RESPONSE TO THE 12 RECOMMENDATIONS

The following is a brief summary of each Recommendation documenting progress and the additional work required before they can be considered ‘complete’. The Ministry of Environment has taken the lead on all recommendations with the exception of Recommendations #4 and #6. Those are led by Emergency Management BC (EMBC) and they have provided the responses for those items. A more detailed status of each recommendation can be found in Appendix 1.

Recommendation #1: *The Ministry of Environment should review its record keeping practices to ensure that proper and complete files are kept and archived on all dam structures, including details of water licenses, transfers of appurtenancy, and correspondence with owners. Note: Linked to Recommendation #9 regarding the Dam Registry.*

In May 2010, the Ministry released a new E-Licensing system within which resides the Dam Registry. This system streamlines and simplifies water management record keeping and training has been provided for all water management staff, including the Dam Safety Officers. The new system allows cross referencing and improves the linkage between the new Dam Registry and other existing electronic and historic paper files making it easier to locate and store all of the relevant files for a single dam.

Recommendation #2: *The Ministry of Environment should review the historical warnings about the conditions of the dam and any actions taken to hold the owner(s) responsible for inspection and maintenance as per the Dam Safety regulation.*

A review of the historical warnings and actions taken relating to Testalinden Dam confirmed that the summary provided in the Deputy Solicitor General's report (p 7 – 10) is accurate and complete. Related to the Testalinden Dam failure, the Ministry's Conservation Officer CEI Unit have initiated an investigation and an Order under the *Water Act* has been issued. The dam needs to be stabilized prior to winter to ensure that the potential for impounding water is removed. Lessons learned from the Testalinden Dam failure related to record keeping and follow-up when deficiencies are identified in a dam are documented in Appendix 1, Recommendation #2 and are being incorporated into the Dam Safety Program as described in the response to other recommendations including Recommendations #1, #8, #9, #10 and #12.

Recommendation #3: *The Ministry of Environment should consider implementing signage at all dam locations to make it clear to passersby that the structure is a dam and to provide direction and emergency contact information, including contact information for the owner, to report any issues observed.* Note: This Recommendation is closely linked to Recommendation #7 regarding an update of the BC Dam Safety Regulation.

An amendment to the BC Dam Safety Regulation has been drafted to require dam signage for very high, high and low consequence dams on Crown Land. The Regulation amendments will be submitted to Cabinet in the fall of 2010. The proposed signage would provide a passerby with information on what conditions to be aware of and emergency contact information. A communication plan has been prepared to advise dam owners of the Regulation amendments as soon as they are approved. Signage of dams on public lands improves the ability of passersby to be aware of issues and report them to the appropriate agency.

Recommendation #4: *Emergency Management BC should work with local officials, local and provincial policing and first response agencies and ministry provincial and regional offices to provide a quick reference list of key contact numbers, focused on "who to call when," and develop an alert matrix to quickly escalate priority issues. Note: Linked to Recommendation #5.*

EMBC has confirmed that the existing processes and contact numbers for reporting emergency situations are appropriate (911 for all urgent life safety issues; non-emergency numbers for local police and fire services for public reporting of other issues; and 1-800-663-3456 for partner agencies and local governments to contact the Province's Emergency Coordination Centre). These contact numbers are the starting point for any emergency situations in the Province. Through seasonal readiness and Temporary Emergency Assignment Management System meetings, Emergency Management BC (EMBC) is committed to confirming and reinforcing existing reporting procedures, relationships and emergency contacts through collaboration with local authorities, first responders and Ministries, including the Dam Safety Program, to ensure that all public safety partners understand the role of EMBC Emergency Coordination Centre and ensure that current EMBC standard operating procedures for environmental emergencies are up to date including emergency contact information. This knowledge will enhance public safety emergency reporting and ensure timely, efficient referral and escalation of emergencies.

Recommendation #5: *The Ministries of Forests and Range and Environment should review their call-out procedures to ensure that compliance and enforcement personnel are familiar with the issues escalation process noted in Recommendation 4, as they are often among the first individuals aware of local incidents.*

The Water Management Branch, Conservation Officer Service and the Ministry of Forests and Range Compliance & Enforcement Branch are working to improve staff awareness of Emergency Management BC's role and call out process. Call out procedures have been reviewed and key contact numbers have been confirmed.

Recommendation #6: *Building on recommendation 4, Emergency Management BC should continue to coordinate awareness and encourage training and orientation for local emergency response agencies, local government officials, and provincial government agency personnel to prepare for emergency situations. Local government are required to have emergency plans in place, per the Emergency Program Act, and Emergency Management BC can assist with the development and testing of these plans.*

EMBC has identified the following deliverables to help ensure local governments understand the risk in their jurisdiction due to the presence of dams and other hazards and encourage dialogue between local governments and dam owners: Formal and informal emergency management training to local government to ensure effective emergency preparedness and response; development of a new emergency management training model designed to be delivered by EMBC regional office staff as part of local government outreach activities; and, through EMBC Integrated Public Safety, continue with and enhance efforts to facilitate improved communications between local governments and external critical infrastructure stakeholders.

Recommendation #7: *The Ministry of Environment should review and update the Dam Safety Regulation to incorporate best practices on dam safety found in other jurisdictions. This would include but is not limited to an update to the downstream consequence classification tool, inclusion of a requirement for the owner to develop an emergency preparedness plan for the structure, and consideration of further regulatory oversight to enhance enforcement and compliance.*

An amendment to the Regulation has been drafted. Proposed changes will improve dam safety by reducing the potential for confusion on dam classification, through adaptation of the Canadian Dam Association system, and by increasing the accountability and awareness of dam owners to the significance of their dams, and, through signage at dams on Crown Land (Recommendation #3).

Recommendation #8: *The Ministry of Environment should complete its Rapid Dam Assessment Project and update its consequence rating system accordingly to determine priority areas in need of attention. The Ministry should develop an action plan to address those areas needing immediate attention and schedule appropriate follow up based on overall findings.*

Of the 1900 dams currently in the Dam Registry, 1132 were included in the Rapid Dam Assessment. Issues with four dams that required immediate action by the dam owner have all been addressed. An additional 379 dams were identified as requiring less urgent follow-up and these are being prioritized for response. The Assessment program provided the opportunity to update the Dam Registry improving government's ability to accurately report on and administer the dam safety program.

Recommendation #9: *The Ministry of Environment should continue its work in building a robust Dam Registry, with linkages through to geo-reference tools which can be utilized by other partners.*

Emergency planning and access to information on dams in British Columbia is a key role in Dam Safety. The recently released E-Licensing system and the Data Registry held within it provide the Dam Safety Officers with a new tool for inputting, accessing and maintaining dam information. This system also geo-references dam information through iMap and Google Earth so that dam location information is now publically available on the internet ([BC Dams](#)). Informing partners on the location of dams is a valuable tool for emergency response planning.

Recommendation #10: *The Ministries of Environment and Transportation and Infrastructure need to continue to ensure effective communication and information sharing of community development and transportation initiatives as they relate to downstream consequences for dam safety. This information should be periodically reviewed on a priority basis to account for any historical changes. In addition, other ministries such as Forests and Range and Energy Mines and Petroleum Resources should be linked in to any consequence review initiatives to ensure that all appropriate information is considered on a periodic basis.*

Revised Flood Hazard Area Land Use Management Guidelines (Section 3.2.6) have been developed and provided to the Water Policy and Legislation Committee. Once approved, these guidelines will be provided to all local governments and the Ministries of Forests and Energy Mines and Petroleum Resources. When implemented, the Guidelines will help ensure clear communication and information sharing between approving officials within local and provincial governments, Dam Safety Officers and dam owners.

Recommendation #11: *The Ministry of Environment should ensure the consistent oversight and regulation of all water related structures, including licensing, standards and risk assessments, by working with the ministries that have the legislative authority. The Ministry should build a business case to rationalize the types of resources and supports that would be needed to accomplish this recommendation.*

The Ministry of Environment reviewed downstream safety provisions in place for mining dams, dikes, and water conveyance structures and compared these to the Dam Safety Program. Recommendations to improve consistency in how water-related

structures are regulated are being prepared. Once finalized, these recommendations will be discussed with the Ministry of Energy Mines and Petroleum Resources to determine if the changes are warranted.

Recommendation #12: *The Ministry of Environment should continue to expand its education and awareness initiatives with dam owners and should work with Emergency Management BC to ensure that dam owners are working directly with local government officials in tying together their emergency preparedness and response plans. In addition, the Ministry of Environment should publish an annual Dam Safety Program report on its public website for the information of the public.*

Educating dam owners about the maintenance, inspection and safe operation of their dams is the first line of defence in preventing dam failures, and a cornerstone of the Dam Safety Program. Linking dam owners with provincial and local government emergency response officials brings dam owners into the BC Emergency Response Management System. Additional opportunities have been identified for staff to speak to dam owners and local government officials. Other Recommendations previously discussed also increase opportunities for education and awareness (e.g. Recommendations #3, 4, 5, 6).

SUMMARY OF THE DAM SAFETY PROGRAM REVIEW

BC is one of four provinces in Canada with a formalized dam safety program. Program staff provide oversight to nearly 2000 dams in the Province including some of the largest structures in Canada. As a result of the Testalinden dam failure, staff from the Ministry of Environment conducted an internal review of the Dam Safety Program. This review builds on a 1995 external review of the program by Semmens and Adams. As a result of the review the Ministry will give a higher priority for dam safety activities among other competing water management activities, this includes providing an additional 4 Dam Safety positions to the program, to increase audits, improve data management and provide for follow-up of outstanding dam safety issues. This addition along with refocusing priorities will improve BC's Dam Safety Program. Program staff have also begun to consider how to address other water retaining structures as provided in our response to Recommendation #11 above and in Appendix 1. In addition, a systematic evaluation of all Ministry owned dams has been initiated to ensure that adequate funding and oversight are in place to manage these structures, provide physical upgrades or removal if warranted.

CONCLUSIONS

As was concluded in the July 2010 Deputy Solicitor General Report on the Testalinden Dam failure, more could have been done to avert the disaster caused by the debris torrent and mudslide and a number of program changes are being made. As Semmens and Adams stated in their 1996 report, "Dams can and do fail" and while the Dam Safety Program can not eliminate dam failures, it can and does reduce risks associated with dams in British Columbia.

Fundamental to this approach is a reemphasis and priority on dam safety. As recommended by the Deputy Solicitor General, a number of improvements to the Provincial Dam Safety Program have and will be made. These include the rapid dam assessment, the completion of an updated Dam Safety Regulation, an updated provincial database (the Dam Registry) along with greater access to this information by local governments. New policy and procedures are being developed to improve record keeping, information sharing and emergency call-out. Additional training by Ministry staff has been planned and will occur over the upcoming year. Training will target provincial and local government staff and external dam owners to update them on these program changes and bring focus to the responsibilities of dam owners.

Over 1,100 dams were reviewed in the past few months as part of the provincial Rapid Dam Assessment. This assessment has greatly improved the Dam Registry and follow-up is underway for the one-third of the dams identified as requiring some form of action.

In summary, all of the recommendations of the Deputy Solicitor General have been accepted and changes made or underway.

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Recommendation #1: Dam Safety Record Keeping Practices

The Ministry of Environment should review its record keeping practices to ensure that proper and complete files are kept and archived on all dam structures, including details of water licences, transfers of appurtenancy, and correspondence with owners.

DELIVERABLES: Review of Dam Safety Record Keeping Practices and Implementation of Changes to improve Dam Safety in British Columbia. This Recommendation is closely linked to Recommendation #9 regarding the Dam Registry.

STATUS

Background: In 1979 a system for filing information specific to individual dams was developed. The concept was based on individual dam file numbers called “D-File” numbers. The numbering convention provided a unique “identifier” for each dam/reservoir making it possible to geo-reference the dams on a map, and giving Dam Safety Officers information about the nature, location, and number of dams on a reservoir. The original purpose of creating a file for each dam was to collate all the relevant information on a dam into one location. Prior to that, dam information was often spread amongst more than one water licence file due to there being more than one licence purpose and/or more than one licensee.

The 1986 Policy & Procedure Manual for Dam Safety was clear on the procedure for information storage for Major Dams with a separate file for each dam but the procedure for “Minor” Dams was not well documented. Separate “Inspection Books” were often kept with important information not placed on files. This has resulted in incomplete and duplicate information.

Present: The record keeping practices of Water Management Branch are rapidly moving from paper files to electronic format. Coincident with the Testalinden Dam failure, the Ministry of Environment was implementing E-Licensing within which is the Dam Registry. Under development for several years, this system creates a dynamic link between electronic Dam Safety records and Water Licensing records resulting in a simpler, more efficient system of record keeping and an improved Dam Registry. The concurrence of E-Licensing implementation and the Rapid Dam Assessment (Recommendation #8) has resulted in all dam safety staff being fully trained in the use of E-Licensing and the Dam Registry being brought substantially up-to-date.

E-Licensing is a multifaceted database used to manage work processes. It allows staff to record and share water related information. When viewing dam information (including the Dam file number) a user may link through the Point of Diversion (PD) number to the Water Licence information (including Water Licence file numbers). There are often multiple water licences and water licence holders associated with one dam. Each water licence has its own paper file and the dam also has its own paper file. Paper files are valuable for historical research purposes however the most recent information is obtainable through E-Licensing. All water licensing activities including applications, new licences, amendments, cancellations, abandonments and name transfers must now be undertaken through E-Licensing.

RECOMMENDATION #1
APPENDIX 1

Accordingly, the E-Licensing information is the most current available and should be reviewed by Dam Safety Officers when making decisions along with the historic paper and electronic files.

Four licence purposes have been identified as being of particular interest to Dam Safety Officers; storage, storage for power, storage for conservation and Permits on Crown Land for dams. Whenever licensing activities involving these purposes occur, a Dam Safety Officer receives a notification on his “To-Do List” in E-Licensing. The Dam Safety Officer may then acknowledge and mark the notification “completed” or he or she may take whatever follow-up action deemed appropriate.

How the Ministry Dam Safety Record Keeping Practices Improve Dam Safety in BC

Accurate and complete dam safety records are required to allow ready access to information about any dam in British Columbia at any time. At the time of the Deputy Solicitor General’s review, considerable improvements to Water Management record keeping practices were already in progress with the E-Licensing database just introduced and staff starting to use it. The use of the “D-File” numbers for dams has been retained. This combined with cross-referencing available within E-Licensing improves the linkage between the new Dam Registry and other existing electronic and historic paper files making it easier to locate all of the relevant files for a single dam.

FOLLOW-UP REQUIRED

- Ensure Dam Safety Officers continue to utilize E-Licensing to record appropriate dam information through annual audits on the use of E-Licensing reporting in the Annual Dam Safety Report.
- Modify E-Licensing so users have a direct link (via ‘Dams’ tab) to the dam registry from the licence view page.
- Provide on-going training to Dam Safety Officers to ensure that they are fully utilizing the capabilities of E-Licensing and continue to access paper and electronic files for historic information.
- Update the dam component of the E-Licensing training manual by the end of 2010.

BUDGET & RESOURCE REQUIREMENTS

The Ministry will ensure that sufficient resources are available within annual budgets for training of Dam Safety Officers on E-Licensing and for annual audits to ensure that appropriate information is being captured by Dam Safety Officers.

Recommendation #2: Review of Testalinden File & Action to Hold Owner(s) Responsible

The Ministry of Environment should review the historical warnings about the conditions of the dam and any actions taken to hold the owner(s) responsible for inspection and maintenance as per the Dam Safety regulation.

DELIVERABLES: Chronology documenting historical warnings on Testalinden Dam & steps being taken to hold owner(s) responsible as per Dam Safety Regulation.

STATUS

Review of Historical Warnings

Ministry of Environment staff undertook a review of all information available on file in the Penticton and Victoria ministry offices related to the Testalinden dam shortly after the dam failure. A chronological summary of dam inspections and warnings to the licensee(s), as well as information related to the transfer(s) of the licence were compiled in a spreadsheet.

Ministry staff were able to affirm that the section of the Deputy Solicitor General’s report dated July 2010 entitled “A Brief History of the Testalinden Dam Failure” (pages 7 to 10) provides an accurate summary of the information reviewed in the Penticton and Victoria files. Furthermore, the Ministry of Environment supports the Deputy Solicitor General’s conclusion that “... *there was sufficient evidence to see a consistent pattern of concerns and warnings about the state of the structure dating back to the 1960’s. There is also no indication that actions had been taken to remedy the situation that has persisted for decades.*”

Steps Being Taken

- 1) The Conservation Officer CEIU Unit have initiated an investigation regarding the failure of the Testalinden Dam. The investigation is ongoing, however, once finalized this report will be forwarded to the Attorney General for review and consideration of further action. The investigation will review contravention of any statutes and regulations, including, but not limited to the *BC Dam Safety Regulation*.
- 2) A *Water Act* Order dated August 3, 2010 was issued by MOE to Mr. Ace Edward Elkink of Elkink Ranch Ltd. The following is a paraphrased summary of the most significant required actions of the order:
 - a. *Immediately cease and desist, any work on or alteration, to all or any part of the breached Testalinden Lake dam until written authorization is obtained for the Regional Water Manager.*
 - b. *By October 31, 2010, stabilize the existing dam, under supervision and in accordance with plans and specifications prepared by a suitably qualified professional engineer, all to the satisfaction of the Regional Water Manager.*

RECOMMENDATION #2
APPENDIX 1

- c. *By November 15, 2010, submit a report from the suitably qualified professional engineer to the Regional Water Manager confirming that the breach in the Testalinden Lake Dam has been stabilized as required in accordance with the Order.*

FOLLOW-UP

- A letter dated September 3, 2010 was received from the law firm representing Mr. Ace Edward Elkink of Elkink Ranch Ltd. This letter indicated that their client intends to comply with the above-referenced Order.
- MOE staff will monitor progress to ensure compliance with the *Water Act* Order dated August 3, 2010.

BUDGET & RESOURCE REQUIREMENTS

No additional budget or resources are required.

RISKS or OUTSTANDING ISSUES

- Limited risks remain from this site.
- The dam needs to be stabilized prior to winter to ensure that the potential for impounding water is removed.

ADDITIONAL RECOMMENDATIONS

The following additional recommendations result from 'lessons learned' from the Testalinden Dam failure relating to record keeping and follow-up required when deficiencies are identified with a dam. These recommendations are being implemented within the Dam Safety Program and through the response to other Recommendations from the Deputy Solicitor General.

- Additional dedicated resources allocated to regional operations Dam Safety program;
- Better tracking of deficiencies and follow-up, providing increased assurance that deficiencies are being adequately resolved;
- Escalate compliance and enforcement action if a dam owner does not comply with resolving deficiencies;
- Deficiencies should be prioritized and tracked based on risk;
- Enhanced data system to manage deficiencies and follow-up; and
- Increase assessment of downstream areas which could be affected with more focus on areas that are vulnerable to slope instabilities and failures i.e. debris torrent prone areas.

Recommendation #3: Dam Signage

The Ministry of Environment should consider implementing signage at all dam locations to make it clear to passersby that the structure is a dam and to provide direction and emergency contact information, including contact information for the owner, to report any issues observed.

DELIVERABLES: Amendment to the BC Dam Safety Regulation to include dam signage for very high, high and low consequence dams on Crown Land and communication of the new requirement to dam owners.

STATUS

The Ministry of Environment has included a requirement for dam signage in a pending amendment to the BC Dam Safety Regulation (Recommendation #7). The proposed signage regulation will apply to all very high, high and low consequence dams located on Crown Land (approximately 288 dams) and as proposed requires two signs at each dam, each approximately 0.75 x 0.60 metres situated such that it is visible from up to a 12-15 metre distance. One sign would be positioned at each end of the participating dam, near the locations where the dam crest abuts the foundation.

Each sign will include the information shown below on a sample design for the sign, provided by the Ministry of Transportation and Infrastructure's Provincial Sign Program.



How dam signage will improve dam safety in BC

Two days before the Testalinden Dam failed a hiker noticed that Testalinden Lake was overflowing onto the road. However, although the hiker contacted local authorities, this potential early warning did not reach the right officials. If the hiker had encountered one of these proposed signs, both the Provincial Emergency Plan and the dam owner could have been contacted immediately.

Mandating through regulation that dam owners of dams in BC that are situated on Crown Land and that are currently classified as very high, high, and low are required to install and maintain two dam safety signs per dam will improve dam safety in BC by providing emergency communication information to passerby in the event that they witness a potential safety hazard.

FOLLOW-UP REQUIRED

The timeline for the implementation of the Dam Signage Program is dependent on passage of the proposed Regulation amendment and the ability of dam owners to create and install their signs. The latter is dependent on seasonal weather conditions.

As documented in Recommendation #7, once the Regulation is approved, a letter will be sent to all dam owners to introduce the amendments to the BC Dam Safety Regulation including the requirements for the BC Dam Safety Signage Program. Owners of dams that are classified as very low will also be advised of the regulation amendment because although they will not be affected by the Signage Program at present, the classification of their dam may change with time.

BUDGET & RESOURCE REQUIREMENTS

The Ministry of Transportation and Infrastructure's Provincial Sign Program has estimated a cost of \$36.50 per sign, and \$336.50 per sign with installation. Research has also indicated that annual maintenance is 30% of the initial cost as such signs are common targets for graffiti and gun shots. The Dam Signage Program will require dam owners to meet specifications provided by the Ministry of Transportation and Infrastructure that help ensure enhanced protection and longevity (12 -15 years) of signs.

At present, the Province owns 51 dams throughout BC, of which 32 are classified as very high, high or low. The cost to the Ministry of Environment for installing two signs per dam site for the 32 dams that are classified as very high, high or low is estimated to be a minimum of \$21,536 and \$6,461 for annual maintenance.

RISKS or OUTSTANDING ISSUES

- A signage program increases the administrative and financial burden of a dam;
- Although two signs would be situated at each end of the dams, these signs may not always be encountered by passerby in large areas such as dam sites;
- By not including the dams that are classified as very low or that are situated on private land, on which a passerby would be trespassing, there remains a risk that should an issue arise with one of these dams, appropriate communication and response may not happen. This risk will be

addressed to some extent through communication efforts resulting from addressing other Recommendations in the Solicitor General's Report (e.g. Recommendations 4, 5, 6 and 12).

ADDITIONAL RECOMMENDATIONS

- None

Recommendation #4: Who to Call When Reference List & Alert Matrix

Emergency Management BC should work with local officials, local and provincial policing and first response agencies and ministry provincial and regional offices to provide a quick reference list of key contact numbers, focused on "who to call when," and develop an alert matrix to quickly escalate priority issues.

DELIVERABLES:

- Provision of a quick reference list to public safety partners which would clarify who to notify in the event of an emergency.
- Development of an alert matrix which would clarify how priority issues are to be escalated to the appropriate authorities.

STATUS

EMBC has confirmed that the existing processes and contact numbers for reporting emergency situations are appropriate. The following points of contact are the starting point for any emergency situations in the Province:

- **911** - For public facing emergency reporting, 911 is a highly effective point of contact, and it is key that the 911 reporting process is not undermined. The public should continue to be encouraged to call 911 for a "life/safety" emergency where someone's health, safety, or property is in jeopardy or a crime is in progress and to otherwise call the non emergency contact number for the local police or fire department. (Alternate local emergency contact numbers must be used for police and fire services in some remote locations that do not have 911 service).
- **EMBC Emergency Coordination Centre** - For Local Authorities, Ministries, and other Utilities and Agencies the existing reporting system through the Emergency Coordination Centre is effective. EMBC's Emergency Coordination Centre will continue to be the 24/7 one window reporting conduit for issues/emergencies requiring provincial government response and escalation. This includes dam/dike breaches, landslides, debris flows and flooding.

EMBC will continue to collaborate with Local Authorities, First Responders, and Ministries (including the Dam Safety program), to ensure that all public safety partners understand the role of EMBC Emergency Coordination Centre and ensure that current EMBC standard operating procedures (Emergency Coordination Centre hotsheets) for environmental emergencies are up to date including emergency contact information.

How the actions taken will Improve Dam Safety in BC

Confirming and reinforcing existing reporting procedures, relationships and emergency contacts will enhance public safety emergency reporting and ensure timely, efficient referral and escalation of emergencies.

FOLLOW-UP REQUIRED

- Reinforce reporting processes through seasonal readiness meetings with public safety partners.
- Temporary Emergency Assignment Management System (T.E.A.M.S.) members training and communication for hazard specific education.
- Communicate and reinforce the importance of updating emergency contacts.

BUDGET & RESOURCE REQUIREMENTS

- EMBC managers will continue to work closely with, and communicate regularly with, local officials and will take advantage of opportunities to strengthen awareness of emergency contact numbers and processes. In addition, EMBC will review options and resource requirements to enable additional/enhanced outreach activities. Such additional/enhanced activities could include additional regional seasonal readiness meetings; T.E.A.M.S. members training sessions; Ministry, Agency and Local Authority presentations; and, participation in exercises.

RISKS or OUTSTANDING ISSUES

- In the event of an emergency, 24/7 EMBC staff may refer to designated contacts within a Ministry/Agency or Local Authority which does not currently maintain 24/7 staffing/points of contact. A delayed response by that Ministry/Agency or Local Authority can sometimes result. EMBC will be following up with partner agencies to discuss solutions to this issue such as on call staffing.

ADDITIONAL RECOMMENDATIONS

- None

Recommendation #5: Call-Out Procedure Awareness

The Ministries of Forests and Range and Environment should review their call-out procedures to ensure that compliance and enforcement personnel are familiar with the issues escalation process noted in Recommendation 4, as they are often among the first individuals aware of local incidents.

DELIVERABLES: Improved awareness by compliance and enforcement personnel of dam related issues and the issues escalation process noted in Recommendation 4.

STATUS

A letter has been sent to Dan Graham, Director, Compliance & Enforcement Branch, Ministry of Forests and Range and Tom Clark, Executive Director, Compliance Division, Ministry of Environment to inform them of the response from Emergency Management BC regarding a “quick reference list of key contact numbers” for reports of potential threats to health, safety or property. The letters also confirm a previous offer of education and awareness instruction for management and staff with these two agencies.

An offer has been made to both the Conservation Officer Service and the Ministry of Forests and Range Compliance & Enforcement Branch for Dam Safety staff to give dam safety presentations to their staff. The presentations will be delivered at regularly scheduled staff meeting for both groups. In addition, some Ministry of Forests and Range Compliance & Enforcement field staff received dam safety training from the Regional Dam Safety Officers in August and September of 2010 while training them to do Rapid Dam Assessments as part of the province wide assessment of all dams. This training will help them to determine the safety of any dams they come across during the course of their regular duties.

How the actions taken will Improve Dam Safety in BC

Educating dam owners about maintaining, inspecting and safely operating their dams is the first line of defence in preventing dam failures. Education and awareness is also important for first responders so that they understand the damage that can occur as a result of a dam failure. Linking dam owners with provincial and local government emergency response officials brings both dam owners and responders into the BC Emergency Response Management System (BCERMS).

FOLLOW-UP REQUIRED

A schedule will be prepared for presentations to be given to management and staff in the two organizations. Regular education and awareness for these agencies will be incorporated into the Dam Safety Work Plan. Contact information for the Conservation Officer Service and the Ministry of Forests and Range Compliance & Enforcement Branch will be incorporated into the Dam Emergency Response Plan (DERP). The DERP is a document prepared by the Dam Safety Program which is a requirement for “responsible Ministries” under the Emergency Program Act.

BUDGET & RESOURCE REQUIREMENTS

The educational material for this project is already available. As noted in the “Budget and Resource Requirements” section of recommendation # 12, the additional resources required are additional travel budget and trainers. Consideration should be given to establishing an annual fund to hire contractors to coordinate and deliver educational programs for the Water Management Branch.

RISKS or OUTSTANDING ISSUES

- None

ADDITIONAL RECOMMENDATIONS

- None

Recommendation #6: Continue to coordinate awareness and encourage training and orientation for local emergency response at all levels

Building on recommendation 4, Emergency Management BC should continue to coordinate awareness and encourage training and orientation for local emergency response agencies, local government officials, and provincial government agency personnel to prepare for emergency situations. Local government are required to have emergency plans in place, per the Emergency Program Act, and Emergency Management BC can assist with the development and testing of these plans.

DELIVERABLES:

- Continued coordination of awareness and encouragement of emergency management training for public safety partners.
- Assistance with development and testing of local authority emergency plans. (Specific deliverables/steps are identified below.)

STATUS:

Steps being taken

EMBC works in close cooperation with local emergency response agencies, local government officials, and other provincial government agency personnel, in addition to other public safety partners, to plan, prepare for, respond to, and recover from emergencies. Key to this close working relationship are efforts to build emergency management awareness, encourage training, and assist with the development and testing of local authority plans.

With respect to Recommendation #6 above, EMBC has identified the following focuses for continued efforts:

- Formal and informal emergency management training for local governments to ensure effective emergency preparedness and response. Training will include the use of planning tools such as the Hazard Risk Vulnerability Analysis (HRVA) toolkit as well as appropriate use of the EMBC Emergency Coordination Centre's 24/7 toll free line for public safety issues.
- Development of a new emergency management training model designed to be delivered by EMBC regional office staff as part of local government outreach activities.
- Through EMBC Integrated Public Safety, continue with and enhance efforts to facilitate improved communications between local governments and external critical infrastructure stakeholders.

How the actions taken will Improve Dam Safety in BC:

Training in the use of the HRVA toolkit will ensure local governments understand the risk in their jurisdiction due to the presence of dams and other hazards. This, in turn, should facilitate dialogue between the local emergency program and the dam owner and allow the local government to ensure that appropriate emergency response plans are in place.

FOLLOW-UP REQUIRED

- Ongoing outreach by EMBC regional staff to local governments and volunteers.
- Completion of development work on new emergency management training modules to be delivered by EMBC regional managers to local government officials and volunteers.
- Delivery of training using the above modules, and related discussions with local government officials and volunteers regarding risk assessments, local emergency plans, and training needs.
- EMBC to require that regional office staff outreach is documented and any training gaps that are noted are addressed with follow up action plans.
- Longer term goals include development of web-based training modules.

BUDGET & RESOURCE REQUIREMENTS

- Fiscal constraints have affected the availability of training for local authority emergency managers and Emergency Social Services (ESS) volunteers.
- EMBC has been working with local governments and volunteers to bolster emergency management capacities through informal training opportunities, outreach, and the development of formal but streamlined training that can be delivered directly by EMBC regional managers. EMBC is currently assessing potential funding sources for formal training delivery costs of approximately \$80,000/yr.
- In the longer term, development and delivery of comprehensive web-based training modules are key priorities for EMBC. EMBC will be developing cost estimates for development and delivery of these modules and will be reviewing options to address resource requirements.
- As noted above, EMBC managers will continue to work closely with and communicate regularly with local officials. In addition, as noted in the response to Recommendation #4, EMBC will review options and resource requirements to enable additional/enhanced outreach activities.

RISKS or OUTSTANDING ISSUES

- The new training delivery model depends upon use of EMBC managers and staff that are often involved in high priority emergency response operations. EMBC will assess how such operational impacts on training delivery can be minimized.

ADDITIONAL RECOMMENDATIONS

- None

Recommendation #7: Review and Update Dam Safety Regulation

The Ministry of Environment should review and update the Dam Safety Regulation to incorporate best practices on dam safety found in other jurisdictions. This would include but is not limited to an update to the downstream consequence classification tool, inclusion of a requirement for the owner to develop an emergency preparedness plan for the structure, and consideration of further regulatory oversight to enhance enforcement and compliance.

DELIVERABLE: Updated Dam Safety Regulation.

STATUS

The Dam Safety Regulation 44/2000 has been revised by Water Management Branch with input from the Dam Safety Officers and assistance from legal counsel. The Regulation is expected to go forward in the fall of 2010.

Five principle revisions are proposed:

1. Replace the existing Schedule 1, “Downstream Consequence Classification Guide” with the Dam Classification table in the 2007 Canadian Dam Association (CDA) Guidelines. This dam classification table will allow the classification of all dams in the BC Dam Register to be classified in accordance with the current national standard and avoid any confusion that was created when the CDA revised the classification system in 2007. The current BC Dam Registry in E-Licensing was designed to easily convert over to the new classification system.
2. Owners of dams currently classified as “Low” consequence (like the Testalinden Dam) will now be required to complete and submit to a Dam Safety Officer (DSO), an Emergency Preparedness Plan (EPP). Currently under the Dam Safety Regulation 44/2000, only the owners of High and Very High consequence classification dams are required to prepare and submit an EPP.
3. Clarify the requirements expected of the dam owner in regard to confirming the consequence classification of their dams and their actions taken in the event of the discovery of a potential safety hazard at a dam.
4. Dam Signage: As per our response to Recommendation #3, a new subsection will be added to Section 3, Operation and Maintenance of a dam, to require the owners of the dams defined below to prepare and install 2 signs at each of their dams:
 - a. Dams classified as Very High, High and Low (not Very Low)
 - b. Dams located on Crown land
5. Clarify the roles of the Dam Safety Officer, Regional Water Manager and Comptroller of Water Rights.

How the revised Regulation will Improve Dam Safety in BC

The above proposed changes to the Regulation will enhance Dam Safety in BC by:

- Eliminating any potential for confusion on classification resulting from discrepancies between the BC and Canadian Dam Association systems;
- Increasing the accountability and raising the awareness of dam owners of the significance of their dam in their specific geographic location; reinforcing the need for the dam owner to be aware of the state and condition of their dam and of their responsibilities as a dam owner.
- Provision of signs by dam owners of very high, high and low consequence dams on Crown Land will provide a passerby with information of what to look for and who to contact in the event that they witness a potential safety hazard.
- Clarity on roles and responsibilities to ensure appropriate responses in the case of emergency and non-emergency situations associated with dam safety in BC.

FOLLOW-UP REQUIRED

Once the Regulation has been approved the following steps are required:

- A press release will be prepared to announce the revised Dam Safety Regulation.
- A revision to the document, “Application of the Dam Safety Regulation”, currently on the Dam Safety web site, will be revised to include an explanation of the revised regulation.
- A letter to all dam owners will be sent to introduce the new Dam Safety Regulation.

BUDGET & RESOURCE REQUIREMENTS

No additional budget requirements. Time will be required for Dam Safety Officers to review and accept up to 500 additional Emergency Preparedness Plans from the dam owners with Low Consequence Classification dams.

RISKS or OUTSTANDING ISSUES

- Owners of dams classified as Low Consequence will have additional costs to prepare Emergency Preparedness Plans.

ADDITIONAL RECOMMENDATIONS

- None

Recommendation #8: Rapid Dam Assessment

The Ministry of Environment should complete its Rapid Dam Assessment Project and update its consequence rating system accordingly to determine priority areas in need of attention. The Ministry should develop an action plan to address those areas needing immediate attention and schedule appropriate follow up based on overall findings.

DELIVERABLES: Rapid Dam Assessment (RDA) with updated consequence ratings and plans in place for follow-up on those dams requiring additional investigation, repairs or maintenance.

STATUS

As of September 30, 2010 there are 1900 dams in the Provincial Dam Registry. As summarized in Table 1, of those 1900 dams, 1132 dams were assessed during the Rapid Dam Assessment and 768 dams were deemed not to require assessment because they are known to present a very low risk for one of the following reasons:

- The dam owners have a known, compliant Dam Safety Program that includes regular audits and maintenance (e.g. BC Hydro, Ducks Unlimited, GVRD etc.) – 307 dams;
- The dam was assessed through the Provincial Dam Safety Audit Program within the last 5 years – 339 dams; or
- Based on the Dam Safety Officers observation, judgment and personal knowledge, the dams do not present a credible risk of failure at this time – 122 dams.

The Dam Registry is being updated, including consequence classifications, based on the information gathered during the RDA project. A final report of the number of dams viewed and the status at the time of the Rapid Dam Assessment will be complete on or before November 30, 2010. Follow-up actions from this Rapid Dam Assessment will continue on a prioritized basis for the next 2 years. Progress will be communicated on a regular basis and provided in the Dam Safety Program Annual Report by May 31 of each year.

One of the findings of the RDA project is that there are a significant number of very low consequence dams that are not yet constructed (approximately 127), or breached (approximately 63) which are part of the group of dams requiring follow-up action. These dams comprise approximately 190 of the 379 dams identified as requiring follow-up action in the RDA. Very low consequence dams are not included in the Dam Safety Audit program and there have been minimal “on ground” assessments for many years. A project to cancel the water licences associated with these dams is underway.

In addition, there were many dams discovered that are no longer being used to release stored water as required under their water licence, i.e., the outlet works are not operable or missing completely. The stored water can no longer be released to support the diversion of water from the stream which could result in stream flows being reduced below minimum flows. These dams also present a potential public

safety hazard because they are not being properly inspected and maintained by the dam owners. The Testalinden Dam was an example of this type of dam.

The total number of dams in the Provincial Dam Registry is not a static number. There are new dams being built and added to the Registry from time to time. In addition dams are added to or removed from the registry when:

- Field verification warrants;
- Licence cancellation occurs. For example the dam was never constructed or was breached or otherwise removed; and
- Classification changes. Unregulated dams become regulated if the consequence classification goes up to Low from Very Low.

Table 1. Summary of the number of dams in the Provincial Dam Registry, those included in the Rapid Dam Assessment and those where the status was determined through other mechanisms as documented in the footnotes.

Summary of Rapid Dam Assessment (RDA) Program, June – September 2010 As of September 30, 2010			
Category	Number of dams	Status of Dams from the RDA	
		Status #1 Immediate Attention	Status #2 Follow-up Action
Assessed under the RDA Program June through September 2010	1132	4 ^[1]	379 ^[2]
Not Included in the RDA Status Confirmed by:	768		
• Dam Owner ^[3]	307		
• Dam Safety Officer Audit ^[4]	339		
• DSO Observation ^[5]	122		
Total Dams Assessed to date	1900		
BC Provincial Dam Registry Total	1900		
^[1] Dam Owners were contacted right away – remedial action is complete or underway. ^[2] The number of #2 dams will continue to change as analysis of data and assessment forms is completed. ^[3] Dam owners with a known compliant Dam Safety Program, e.g. BC Hydro, Ducks Unlimited, GVRD, etc. ^[4] Dam was assessed within the past 5 years under the Dam Safety Audit Program. ^[5] Based on the Dam Safety Officers observation, judgment and personal knowledge, these dams do not present a credible risk of failure at this time.			

How the actions taken will Improve Dam Safety in BC

Through the Rapid Dam Assessment four dams were identified that required immediate action by the dam owner and an additional 379 that require less urgent follow-up. In addition, the Assessment program provided the opportunity to ensure that the Dam Registry is current thus ensuring government's ability to accurately report on the overall safety of dams in BC and to direct resources to the highest priority issues.

FOLLOW-UP REQUIRED

Status # 1 Dams: The dam owners of these 4 dams were contacted immediately and the deficiencies have been addressed or are being addressed. One Order under the *Water Act* was issued and the dam owner complied as required.

Status # 2 Dams: A process was established in July following the completion of the first phase of the RDA project for dealing with dams that required less urgent follow-up and some follow-up has been initiated but was interrupted later in July by the requirement to complete an RDA of all dams in BC. The second phase of the RDA was completed in the second week of September and the number of dams requiring follow-up more than doubled as a result. Most of the additional dams requiring follow-up are Very Low Consequence dams. Follow-up actions are prioritized by the Dam Safety Officers based on the outcome of the assessments and will be accomplished as time and resources allow. It is likely that follow-up work could take two years or more and includes the following for each dam that requires follow-up:

- Dam Safety Officer verifies the consequence classification and determines priority of action based on consequence classification.
- Contact the dam owner in writing, identifying the action(s) needed.
- Follow-up with the dam owner until work is completed or initiate the next level of enforcement under the regional compliance escalation process (i.e. site visits, final letters, fines, Orders, etc.).
- Bring Dam Registry up to date.

As described in the response to Recommendation #9, the Dam Registry can now be easily updated by all Dam Safety Officers in the new E-Licensing system. Dam Safety Policy and Procedures will be updated to require that all dam records including consequence classification and risk levels must be updated and continually revised in the registry by Dam Safety Officers. Once updated, this policy will be communicated to Regional Water Managers who are responsible for the delivery of the Dam Safety Program in their region. Enhancements planned for Phase 2 of E-Licensing are required to optimize the Dam Registry (see Recommendation #9).

A report on the follow-up work in each region and Victoria will be included in the Dam Safety Program Annual Reports for the years 2010-11 and 2011-12. These Annual Reports will be posted on the Ministry of Environment web site by May 31 of each year. The information will be compiled by Dam Safety Victoria from reports by the Regional Dam Safety Officers in a format to be determined.

BUDGET & RESOURCE REQUIREMENTS

Resource requirements for follow-up on the 379 dams with Status 2 are unknown at this time but will be identified over the next month for inclusion in the Ministry annual business planning process this fall.

The dams described on page 2 as not constructed, breached or not operable must be addressed. The first 2 categories can likely be dealt with by the addition of resources for two auxiliary staff for a period of six months.. It needs to be acknowledged that the follow-up work to the cancellation process will likely exceed this 6 month time period because some of the licensees will elect to construct or re-construct their dams rather than abandon the licence. The third category of not operable dams will be addressed as part of the follow-up action for the #2 status dams as noted.

RISKS or OUTSTANDING ISSUES

- Continued follow-up for the next 2 years
- Not all owners of not constructed or breached dams will willingly abandon the water licences for their dams. If they want to retain their water rights they will have to follow a process of plans review under the “Plans Review Guidelines”.

ADDITIONAL RECOMMENDATIONS

- None

Recommendation #9: Robust Dam Safety Registry with access by partners

The Ministry of Environment should continue its work in building a robust Dam Registry, with linkages through to geo-reference tools which can be utilized by other partners.

DELIVERABLES: Verification of continued work towards a robust Dam Registry with linkages to geo-reference tools and confirmation that partners have access.

STATUS

The record keeping practices of Water Management Branch are rapidly moving from paper files to electronic format through the use of E-Licensing, released in May-June of 2010. E-Licensing is a multifaceted database used to manage work processes in water management for British Columbia. The Dam Registry resides within E-Licensing and allows staff to record and share water allocation related information including dam information. E-Licensing information is the most current available and can be reviewed by Dam Safety Officers when making decisions and updated when new information is been received.

E-licensing is geo-referenced to iMap and Google Earth to visually display dam locations with links to dam attributes. At this time, not all dam information codes (i.e. operation codes, which would distinguish if mapped dams are active, not constructed, abandoned or breached) are currently geo-referenced to these maps. This iMap and Google Earth link to the Dam Registry data is currently available to the public and all agencies through the dam safety Web page found at: http://www.env.gov.bc.ca/wsd/public_safety/dam_safety/index.html.

Partners including provincial government ministries and agencies as well as local government will be made aware of this vital public safety planning tool in a number of ways including direct contact and through other agency websites (i.e. Emergency Management BC).

How the actions taken will Improve Dam Safety in BC

Emergency planning and access to information on dams in British Columbia is a key role in Dam Safety. The recently released E-Licensing system and the Data Registry held within it provide the Dam Safety Officers with a new tool for inputting, maintaining and accessing dam information. This system also geo-references dam information through iMap and Google Earth making dam location information publically available on the internet. Informing partners on the location of dams is a valuable tool for emergency response planning.

FOLLOW-UP REQUIRED

- Ensure all relevant information in the Dam Registry through E-Licensing is able to be attached into iMap or Google Earth by having the dam spatial view remodelled.

- Educate partners on where to find the geo-referencing information through education and awareness programs, conferences and direct contact and linking our web-sites with other Emergency Planning sites such as Emergency Management BC.
- As documented in the response to Recommendation #1, ongoing effort is required by the Dam Safety Officers to ensure E-Licensing is updated as dam audits or other information changes
- The first release of E-Licensing, including the Dam Registry occurred in May-June 2010. Additional features are planned for E-Licensing but are currently unscheduled due to budget constraints and to allow sufficient time to fully test the current version of the system. The E-Licensing development team will be advised of the required changes and the urgency so that the changes can be prioritized. Phase 2 of E-Licensing is required for the Dam Registry to develop:
 - Improved reporting out, including an Annual Report Summary on all dams;
 - Updates to accommodate the Dam Safety Regulation changes described in Recommendation #7;
 - Additional changes that were recommended in development of phase 1 of E-Licensing that weren't developed because of budget restraints; and
 - Improved input into the Dam Registry from Excel spread sheets.

BUDGET & RESOURCE REQUIREMENTS

Phase 2 of E-Licensing includes enhancements to the Dam Registry and is currently being costed.

RISKS or OUTSTANDING ISSUES

- None

ADDITIONAL RECOMMENDATIONS

- None

Recommendation #10: Information Sharing on upstream dams with Agencies & Local Government involved in development

The Ministries of Environment and Transportation and Infrastructure need to continue to ensure effective communication and information sharing of community development and transportation initiatives as they relate to downstream consequences for dam safety. This information should be periodically reviewed on a priority basis to account for any historical changes. In addition, other ministries such as Forests and Range and Energy Mines and Petroleum Resources should be linked in to any consequence review initiatives to ensure that all appropriate information is considered on a periodic basis.

DELIVERABLES: Revised Flood Hazard Area Land Use Management Guidelines (Section 3.2.6) and a letter sent to all local governments and the Ministries of Forests and Energy Mines and Petroleum Resources advising them of the revised Guidelines and their responsibilities.

STATUS

One of the key findings of the Testalinden Dam Failure Review report was that small developments were approved and constructed downstream of the Testalinden Dam without sharing the information with the Dam Safety Program and revisiting the dam’s hazard consequence classification rating. At the time of the developments, the downstream consequence classification of the Testalinden Dam was “Low”¹. Given the developments downstream, a “Low” rating for the Testalinden Creek Dam was likely inappropriate.

In consideration of the information sharing gaps recognized by Recommendation #10, the Ministry of Environment’s Flood Safety Section has prepared an amendment to Section 3.2.6 of the Flood Hazard Area Land Use Management Guidelines² as follows:

3.2.6 Downstream of Dams

Dam upgrading and/or development restrictions will be necessary if a development proposal increases the dam’s Downstream Consequence Classification per Schedule 1 of the BC Dam Safety Regulation.

The extent of dam upgrading and/or development restrictions shall be determined on a site-specific basis by a qualified professional engineer in consultation with:

- Local government planning and approving officials,
- Ministry of Transportation and Infrastructure development approving officials, if the development occurs in a Regional District,
- Integrated Land Management Bureau approving officials, if the development is on Crown Land,

¹ See Attachment for Schedule 1 of the BC Dam Safety Regulation’s Downstream Consequence Classification Guide.

² See Attachment for a summary of the Flood Hazard Land Use Management Guidelines and the existing Section 3.2.6.

- Dam Safety Officer, and
- Dam owner.

For the locations of all dams regulated by the Ministry of Environment and information about Dam Safety Officers, please visit the BC Dam Safety Program website (www.env.gov.bc.ca/wsd/public_safety/dam_safety).

For developments downstream of dams not listed on the Dam Safety Program's website (e.g. mining dams - impoundments and diversions, sewage lagoons, etc.), it is the responsibility of local government approving officials to get into contact with the dam owner, responsible provincial agency, and if necessary, a qualified professional engineer to determine the extent of dam upgrading and/or development restrictions.

Clauses 3.2.1 to 3.2.4, regarding building setbacks and flood construction levels for watercourses, shall apply downstream of dams rated with a very low consequence classification as determined by the Ministry of Environment's Dam Safety Program.

How the actions taken will Improve Dam Safety in BC

With respect to downstream developments (e.g., subdivisions, re-zoning applications) near dams, this amended guideline will improve dam safety by helping ensure that there is clear communication and information sharing between local government approving officials, provincial government approving officials, Dam Safety Officers, and dam owners.

FOLLOW-UP REQUIRED

The new Guideline is with the Water Policy and Legislation Committee for approval. When the amended guidelines have been approved, the aforementioned letters advising local governments and relevant Ministries of the revised Guidelines will be sent out. As of this time, no training or presentations have been planned, the letters explaining the revisions should suffice.

To ensure awareness and use of the Guidelines, regular communication with other Ministries and with local governments will be required along with an annual audit on use of Guidelines, and inclusion on use of Guidelines at workshops, conferences and other training and educational opportunities.

BUDGET & RESOURCE REQUIREMENTS

The amended guideline will create additional work for local and provincial governments (i.e., Ministry of Transportation and Infrastructure and Information Land Management Bureau). Enacting the amendment may result in an influx of information requests and additional work for Dam Safety Program staff with both dam owners and approving officials regarding developments downstream of dams.

RECOMMENDATION #10
APPENDIX 1

RISKS or OUTSTANDING ISSUES

- None

ADDITIONAL RECOMMENDATIONS

- Include all MEMPR regulated dams on iMap to assist local governments in identifying any mining dams with potential to impact their communities.

RECOMMENDATION 10

AMENDMENT TO FLOOD HAZARD AREA LAND USE MANAGEMENT GUIDELINES

Attachments

- a) BC Dam Safety Regulation – Schedule 1
- b) Flood Hazard Area Land Use Management Guidelines Summary
- c) Existing Section 3.2.6 of the Guidelines

Schedule 1 – BC Dam Safety Regulation
(Sections 2 (1) (d) and 3 (2))
Downstream Consequence Classification Guide

Rating	Loss of Life	Economic and Social Loss	Environmental and Cultural Losses
VERY HIGH	Large potential for multiple loss of life involving residents and working, travelling and/or recreating public. Development within inundation area (the area that could be flooded if the dam fails) typically includes communities, extensive commercial and work areas, main highways, railways, and locations of concentrated recreational activity. Estimated fatalities could exceed 100.	Very high economic losses affecting infrastructure, public and commercial facilities in and beyond inundation area. Typically includes destruction of or extensive damage to large residential areas, concentrated commercial land uses, highways, railways, power lines, pipelines and other utilities. Estimated direct and indirect (interruption of service) costs could exceed \$100 million.	Loss or significant deterioration of nationally or provincially important fisheries habitat (including water quality), wildlife habitat, rare and/or endangered species, unique landscapes or sites of cultural significance. Feasibility and/or practicality of restoration and/or compensation is low.
HIGH	Some potential for multiple loss of life involving residents, and working, travelling and/or recreating public. Development within inundation area typically includes highways and railways, commercial and work areas, locations of concentrated recreational activity and scattered residences. Estimated fatalities less than 100.	Substantial economic losses affecting infrastructure, public and commercial facilities in and beyond inundation area. Typically includes destruction of or extensive damage to concentrated commercial land uses, highways, railways, power lines, pipelines and other utilities. Scattered residences may be destroyed or severely damaged. Estimated direct and indirect (interruption of service) costs could exceed \$1 million.	Loss or significant deterioration of nationally or provincially important fisheries habitat (including water quality), wildlife habitat, rare and/or endangered species, unique landscapes or sites of cultural significance. Feasibility and practicality of restoration and/or compensation is high.
LOW	Low potential for multiple loss of life. Inundation area is typically undeveloped except for minor roads, temporarily inhabited or non- residential farms and rural activities. There must be a reliable element of natural warning if larger development exists.	Low economic losses to limited infrastructure, public and commercial activities. Estimated direct and indirect (interruption of service) costs could exceed \$100 000.	Loss or significant deterioration of regionally important fisheries habitat (including water quality), wildlife habitat, rare and endangered species, unique landscapes or sites of cultural significance. Feasibility and practicality of restoration and/or compensation is high. Includes situations where recovery would occur with time without restoration.
VERY LOW	Minimal potential for any loss of life. The inundation area is typically undeveloped.	Minimal economic losses typically limited to owner's property not to exceed \$100 000. Virtually no potential exists for future development of other land uses within the foreseeable future.	No significant loss or deterioration of fisheries habitat, wildlife habitat, rare or endangered species, unique landscapes or sites of cultural significance.

**FLOOD HAZARD AREA
LAND USE MANAGEMENT
GUIDELINES**



May 2004

Ministry of Water, Land and Air Protection

Province of British Columbia

Introduction to Document and Guidelines

This document provides guidelines intended to help local governments, land-use managers and approving officers develop and implement land-use management plans and make subdivision approval decisions for flood hazard areas.

The goals of the provincial "Flood Hazard Area Land Use Management Guidelines" are to reduce or prevent injury, human trauma and loss of life, and to minimize property damage during flooding events. Experience has shown that regulating land development to keep people out of harm's way is the most practical and cost effective way of achieving these goals.

The guidelines are based on the policies and procedures established and refined over the life of the provincial flood hazard management program.

These guidelines have been prepared pursuant to section 2 of the *Environment Management Act* and must be considered by local governments in making bylaws under section 910 of the *Local Government Act*.

The guidelines are divided into five sections:

- 1.0 Administration – Flood Hazard Land Use Management
- 2.0 Flood Plain Mapping
- 3.0 Application – By Hazard Type
- 4.0 Application – Land Use Specific
- 5.0 Application – Implementation Measures

The Administration section details ways in which decision-makers can manage flood hazards on a broad or area-wide basis, employing strategies such as flood hazard management plans, bylaws and standards, and during the subdivision process.

The Flood Plain Mapping section details the importance and application of flood plain mapping information.

The Application sections provide the provincial requirements for different types of flooding hazards and different land uses commonly found in BC. These are **minimum** requirements that may be increased by the decision-maker depending on local circumstances.

***In the absence of more site-specific studies or information,
these guidelines are the recommended provincial minimum requirements
for land use management in flood hazard areas.***

For certain areas of the province, more site-specific information may be available for the decision-maker's consideration. Sources of site-specific information that may supplement the guidelines include:

- Historical records and descriptions, particularly of previous flooding events at a specific location;
- Flood hazard delineation or management studies;
- Flood plain mapping;
- Engineering and other studies;
- Local government planning documents, such as Official Community Plans and bylaws; and
- Covenants, at the site or in the vicinity.

A survey showing flood hazard management information for individual local governments can be found on the ministry Flood Hazard Management website at: <http://wlapwww.gov.bc.ca/wat/flood/index.html>. The documents may be viewed at the local government office. Other studies or documents may be available from local governments or from the ministry.

In addition, new site-specific studies containing professional evaluation, advice and recommendations including mapping, may be required where the risk to life and property is high, where advice is required to meet provincial flood hazard management guidelines or where modified or new protective works are proposed.

Existing Section 3.2.6 of Flood Hazard Land Use Management Guidelines:

3.2.6 Downstream of Dams

Setback –

Dam upgrading or development restrictions may be necessary if a development proposal increases the Land and Water BC (LWBC) hazard consequence classification for low, high and very high consequence dams (other than dams owned and operated by a major utility). The requirements should be determined on a site-specific basis by a professional engineer in consultation with the dam owner and LWBC.

Clauses 3.2.1 to 3.2.4 should apply downstream of dams rated with a very low consequence classification as determined by LWBC.

Recommendation #11: Project plan and business case development for project to ensure consistent oversight & regulation of water related structures in BC (dams, dikes, penstocks, tailing dams, ditches and canals)

The Ministry of Environment should ensure the consistent oversight and regulation of all water related structures, including licensing, standards and risk assessments, by working with the ministries that have the legislative authority. The Ministry should build a business case to rationalize the types of resources and supports that would be needed to accomplish this recommendation.

DELIVERABLES: Project Plan & Business Case for Oversight and Regulation of Water Related Structures in BC.

STATUS

To address this recommendation, Ministry of Environment (MoE) did a high level review of the downstream safety provisions in place for mining dams, dikes, and water conveyance structures related to Independent Power Producers (IPPs) and compared them to the Dam Safety Program. The Dam Safety Regulation is fairly detailed in the way that it addresses the protection and safety of downstream structures and communities and a further review is underway to determine whether public safety would be materially improved if elements of this regulation were applied to mining dams, dikes, and water conveyance structures. This review will look at the potential costs of any changes. The results of the initial high level review follow.

Mining Dams

According to the Memorandum of Understanding³ between MoE and Ministry of Energy, Mines and Petroleum Resources (MEMPR):

MEMPR is responsible for ensuring that no part of the mine, including a TSF, FI, SED POND and SLUDGE POND (note requiring a Water Licence or Waste Permit) represents a danger either to the health and safety of a person in or about the mine or to the safety of the public, and is also responsible for the protection and reclamation of the surface the land and watercourses on the mine site.

In terms of design, operation, maintenance, review, and safety of their dams, MEMPR adheres to the **Health, Safety and Reclamation Code for Mines in British Columbia (2008)** (Mine Code).

<http://www.empr.gov.bc.ca/Mining/HealthandSafety/Pages/HSRC.aspx>.

Dam safety regulations under the *Water Act* and MEMPR dam safety regulations under the Mine Code are different in several respects therefore it may not be possible to develop completely “consistent oversight and regulation for water related structures, including licensing, standards and risk

³ See Attachment for full version of the Memorandum of Understanding for Regulation of Impoundments and Diversions on a Mine Site.

RECOMMENDATION #11
APPENDIX 1

assessments”. For example, the heights of some tailings dams are continually increased to accommodate additional tailings from mining operations, which can create different dam operation and maintenance procedures from mine to mine. Since conditions can vary from mine to mine, each mining dam is issued an operating permit specifying procedures to follow in addition to those mentioned in the Mine Code.

Nevertheless, possible areas for change include:

1. Specifying how often surveillance on tailing dams should be conducted.
2. Linking the frequency of tailing dam inspection reporting by a professional engineer to risk classification.
3. Extending the requirement for an Emergency Preparedness Plan (EPP) for low consequence major impoundments and an OMS manual for all dams.
4. Confirming whether instrumentation inspections, test operation of outlet facilities, spillway gates and other mechanical components, and the dam safety review should be designed in accordance with the criteria provided in the Canadian Dam Association, Dam Safety Guidelines.

Dikes

The major legislation related to dikes in BC is the Dike Maintenance Act. This legislation is very thorough. The following list discusses potential areas for further work to ensure consistent oversight and regulation of flood protection dikes in BC:

Dike Oversight and Regulation – Administration of the Dike Maintenance Act (DMA)

- Proper Inspection, Operation and Maintenance of Existing Dikes by diking authorities:
 - Educate diking authorities (i.e. dike safety seminars) and create outreach tools to build awareness of safety issues and maintenance standards
 - Establish a dike inspection training certification program. Require that inspection reports be completed and signed off by certified personnel, or a suitably qualified Professional Engineer.
 - Increase compliance through auditing and enforcement
- Update and improve the existing dike databases and geographic information systems (i.e. locations and descriptions of dikes)
- Prepare a Dike Classification system similar to the Dam Safety Program’s.
- Support the DMA approval process and implementation of standards through development and adoption of a dike safety regulation.
- Develop policy, and delineate ownership and responsibilities for the approximately 100 orphan flood protection works in BC.

- Given the scheduled 2012 sunset of the *Drainage, Ditch, and Dike Act*, complete the necessary assessments to facilitate the transfer of five diking districts to their respective local governments.

Standards and Management of Flood Protection Works

- Finalize and adopt sea dike standards (e.g. Richmond, Delta and Surrey) that address sea level rise and climate change
- Determine seismic design standards and criteria for major dike upgrades and new dikes
- For the Fraser River dikes, update the dike crest design profile from Hope to Richmond using the Fraser River hydraulic model. The profile update should address both channel changes in the upstream gravel reach and sea level rise in the downstream sand reach.
- For high consequence dikes, complete quantitative risk assessments to determine the appropriate design standard (e.g. 1:500 or 1:1000) for that specific dike.
- River surveying, hydraulic modeling and sediment studies to ensure that diking systems throughout the province continue to meet provincial standards and account for ongoing channel change)
- Manage flood protection works where the ministry has responsibilities (i.e. Okanagan River system, Mission Creek dikes etc.)
- Documentation of major flood events to assist in developing dike design criteria (e.g. November 2009 Cowichan River flood in Duncan).
- Update environmental guidelines for vegetation management on dikes

Water Conveyance Structures

Safeguards for water conveyance structures are the domain of the Professional Engineer involved in the design of these water conveyance structures.

There are approximately 40 IPPs in BC. Most IPPs are remotely located and would have minimal effect on downstream communities were there to be a water breach. Aligning water conveyance structures to the Dam safety standards would require significant work to classify the downstream consequence and conduct audits/reviews on any high to very high consequence structures that might exist. Ultimately, a safety regulation for water-conveyance structures would need to be established if government determined the risk warrants further regulation.

How the actions taken will Improve Dam Safety in BC

The above actions could improve safety of water related structures and create a more uniform way in which water-related structures are regulated.

FOLLOW-UP REQUIRED

Considerable resources would be required to implement these actions and additional discussions are necessary with the Ministry of Energy Mines and Petroleum Resources, within the Ministry of Environment and with industry to determine if the changes are warranted

ESTIMATED BUDGET & RESOURCE REQUIREMENTS

To be determined

RISKS or OUTSTANDING ISSUES

- The risk of preventable downstream flood damages is greater if the identified actions are not addressed

ADDITIONAL RECOMMENDATIONS

- BC Dam Safety program should consider internally reviewing engineering designs and conducting construction inspections for any new dam to be constructed and regulated under the BC Dam Safety Regulation.
- BC Dam Safety Regulation should require OMS Manuals for all dams.

RECOMMENDATION 11

AMENDMENT TO FLOOD HAZARD AREA LAND USE MANAGEMENT GUIDELINES

Attachments

- a) Memorandum of Understanding – Regulation of Impoundments and Diversions on a Mine Site

Memorandum of Understanding - Regulation of Impoundments and Diversions on a Mine Site

Memorandum of Understanding between the Ministry of Energy, Mines and Petroleum Resources (MEMPR) and the Ministry of Environment (MoE), outlining the responsibilities for the Regulation of Impoundments and Diversions on a mine site including Tailing Storage Facilities (TSF), Flooded Impoundments (FI), Water Storage Facility (WSF), Sedimentation Control Ponds (SED POND), Sludge Storage Ponds (SLUDGE POND) and Diversion Channels (DC).

Purpose

The purpose of this memorandum is to define the role of MEMPR (Mining and Minerals Division, Health and Safety Branch), and MoE (Water Stewardship Division and Environmental Protection Division), in the siting, design, construction, operation, maintenance, abandonment, reclamation, and regulation of impoundments and diversions on a mine site, in order to protect the public, the environment and the users of water in the affected watershed.

Definition

TSF (Tailings Storage Facilities): A reservoir controlled by one or more embankments to store mine tailings and mine process water (supernatant). Tailings are fine rock materials in suspension, which are discharged from an ore concentrator or coal preparation plant. A TSF includes any started dams, seepage collection dams and ponds located beyond the downstream toe of the main embankment(s).

FI (Flooded Impoundments): A reservoir controlled by one or more embankments required to submerge tailings, PAG waste rock, rock cuts or underground workings that have potential to generate acid if exposed to the atmosphere or a reservoir controlled by one or more embankments required to regulate the flow of ARD-contaminated water, including associated sludge storage from water treatment. A TSF may become an FI upon closure of the mine. An FI includes and seepage collection dams and ponds beyond the downstream toe of the main embankment(s).

WSF (Water Storage Facility): A water storage reservoir, situated on a stream or off stream and storing water diverted from a stream, controlled by one or more embankments. A WSF does not include a TSF, FI, SED POND or SLUDGE POND, therefore a water licence is required for surface water storage.

SED POND (Sedimentation Control Ponds): A reservoir controlled by one or more embankments required to store surface water runoff and designed to facilitate the deposition of suspended solids and mitigate the release of sediment to the environments downstream.

SLUDGE POND (Sludge Storage Ponds): These ponds are developed to contain sludge, from water treatment plants, from entering into the receiving environment.

DC (Diversion Channels): Diversion structures (dam or channel) are developed to divert and control the annual inflow of the various watercourses around the mine site. These channels are developed to handle 1 in 200 year flows of the natural watercourse.

General Responsibilities

It is recognized that:

1. MEMPR is responsible for ensuring that no part of the mine, including a TSF, FI, SED POND and SLUDGE POND (note requiring a Water Licence or Waste Permit) represents a danger either to the health and safety of a person in or about the mine or to the safety of the public, and is also responsible for the protection and reclamation of the surface the land and watercourses on the mine site.

2. MoE
 - Water Stewardship Division (WSD) is responsible for the issuing of water licenses or approvals regulating the diversion, use and storage of surface water in or from a natural watercourse including any impoundments or diversion on a mine site. If a water licence is required and these works include a dam as defined under the Dam Safety Regulation, the regulation of the dam by WSD will be commensurate with the downstream consequence classification rating under the Dam Safety Regulation.
 - Environmental Protection Division (EPD) is responsible for the protection of human health and the environment from any adverse effects of mine wastes or impoundments, the use of hazardous materials, and the management of contaminated sites.

Specific Responsibilities

1. MEMPR, under the *Mines Act* and Health and Safety Regulation Code for Mines in BC (Code), is responsible for approving the siting, design, construction, modification, operation, maintenance, abandonment and reclamation of a TSF, FI, SED POND and SLUDGE POND, with some exceptions for any impoundment that requires a water licence (see Joint Responsibilities below). MEMPR uses the Canadian Dam Association (CDA) guidelines referenced under the code. Prior to operation, MEMPR will ensure that sufficient security has been posted to undertake the necessary works to close the impoundments should the permittee default on its responsibilities. After mine closure MEMPR will ensure that the TSF, FI, SED POND and SLUDGE POND is either reclaimed or drained, and if necessary a permanent spillway installed. In the case of a TSF and FI, a valid Mines Act Permit and reclamation bond will be maintained to ensure long-term care, maintenance and/or treatment. In the case of a default MEMPR will assume responsibility or find a third party to assume responsibility in exchange for the reclamation bond.
2. MoE
 - WSD is responsible for licensing or approving any WSF or DC that requires a water licence or approval under the *Water Act* and Dam Safety Regulation. This will include the approval of siting, design, construction, modification, operation, maintenance and decommissioning with the exception of TSF, FI, SED POND and SLUDGE POND (see Joint Responsibilities).
 - EPD is responsible for regulating the quantity and quality of any discharge to the environment from activities relating to mining. EPD is not responsible for regulating the structural safety and integrity of impoundments at a mine site. Where the quantity or the quality of the discharge may be affected by proposed works or operational procedures, EPD may impose requirements for the siting design, construction, modification, operation, maintenance, abandonment, and reclamation of a TSF, FI, DC, SED POND, or SLUDGE POND. All applications for waste management permits and amendments dealing with mine tailings discharges and on the development of any industry codes of practice applicable to mine tailings will be referred to MEMPR for comments and advice.

Notwithstanding the above, WSD and EPD will seek to obtain agreement from MEMPR before permitting, licensing or requiring additional discharges into a TSE, FI, SED POND and SLUDGE POND anticipated in the design of the impoundment. In the event that agreement cannot be reached at the local level, this matter shall be referred to the appropriate Directors for a decision.

Joint Responsibilities

A TSF, FI, SED POND and SLUDGE POND that requires a water licence will be dealt with by MEMPR and WSD on a case-by-case basis. Under such agreements, MEMPR will be the approving agency for the dam design, construction, operation, maintenance and reclamation issuing a water licence, WSD will be responsible for the licensing of water and storage. Prior to issuing a water licence, WSD will confer with MEMPR to confirm that the process for approving the TSF, FI, SED POND and SLUDGE POND as noted above, will be undertaken under the Mines Permit.

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If a water licence is required for a TSE, FI, SED POND and SLUDGE POND it shall be referenced to the closure plan in the Mines Act Permit. WSD will refer to MEMPR for comments and advice on all applications for water diversions relating to a TSF, FI, SED POND and SLUDGE POND.

All signatories of this MOU will endeavor to ensure that copies of all permits or licence's (and any revisions) are made available to the other signatories with an interest in the permit or licence.

Consultation and Coordination

During the project review for an Environmental Assessment Certificate and *Mines Act* Permit, MEMPR and MoE shall jointly review any TSF, FI, WSF, DC, SED POND and SLUDGE POND as per the terms of this agreement. Reviewer by MEMPR and MoE will be coordinated by their Ministry representatives on the Project Committees.

Where an emergency situation at the TSF, FI, SED POND and SLUDGE POND requires action that precludes prior consultation, notification of the actions taken by one party shall be given to the others as soon as possible. Copies of written orders, directives, approvals, licences, permits and amendments thereto, which include a TSF, FI, SED POND and SLUDGE POND shall be transmitted to the other parties at the time of issue.

In the event of the need for clarification of the Memorandum of Understanding or of unforeseen situations, the appropriate Directors shall consult with a view to resolving the matter.

This Memorandum of Understanding replaces the previous Letter of Understanding between MoE and MEMPR signed on September 6 and 9, 1988.

Nothing contained in this Memorandum of Understanding abrogates responsibilities or duties assigned by the *Mines Act*, the *Waste Management Act* or the *Water Act*.

Deputy Minister
Ministry of Energy, Mines and Petroleum Resources
April 22, 2009

Deputy Minister
Ministry of Environment
May 14, 2009

Recommendation #12: Education & Awareness Initiatives

The Ministry of Environment should continue to expand its education and awareness initiatives with dam owners and should work with Emergency Management BC to ensure that dam owners are working directly with local government officials in tying together their emergency preparedness and response plans. In addition, the Ministry of Environment should publish an annual Dam Safety Program report on its public website for the information of the public.

DELIVERABLE: Plan and budget approved for increased education & awareness initiatives; Annual Report to Dam Safety Website.

STATUS

“Education and Awareness” is a key component of the Dam Safety Program and is one of the 4 pillars of the dam owner compliance monitoring program outlined in the 2002 Compliance Strategy. Education and awareness are currently delivered in 4 ways:

- A one day credited workshop through the BC Water and Waste Association (BCWWA);
- Educational material available on the Ministry of Environment web site;
- Presentations and information on Dam Safety to local government officials ; and
- Face to face education of dam owners during the regularly scheduled audits conducted by Dam Safety Officers.

This report outlines a plan to enhance the first three:

1. An initiative to expand the workshops will take 2 directions. Additional one day workshops will now be delivered through other associations such as the Water Supply Association (WSABC) and the BC Cattlemen’s Association (BCCA) as well as the BCWWA. A one day workshop with the WSABC is scheduled for October 20, 2010 in Kelowna. Preliminary discussions with BCCA have occurred to arrange for educational presentations to be delivered by Regional Dam Safety Officers to ranchers at their local meetings.
2. A binder titled “Inspection and Maintenance of Dams” was printed and distributed to all dam owners in 1998. This binder will be updated, re-printed and distributed to all dam owners again. The cost per binder will be \$6.83 plus delivery and postage. Approximately 1400 binders will be sent to each dam owner and an additional 900 will be required for educational purposes for a total of approximately \$20,000.
3. Continue to work with Emergency Management BC and local government officials to engage dam owners in their community with the aim of coordinating local government emergency plans and the dam owner’s emergency preparedness plans. The Provincial Emergency Program (PEP) web site currently has a Hazard Risk Vulnerability Analysis (HRVA) tool to assist local governments in this regard. A request has been made to PEP to add the Dam Safety Program web link to the front page of the PEP web site. Will Jolley, Dam Safety Section Head will give a

RECOMMENDATION #12
APPENDIX 1

presentation to the annual Emergency Preparedness Conference in Vancouver on November 23. This large annual conference is the largest annual meeting of BC emergency response officials including Federal, Provincial and Local Governments. Please see Recommendation #6.

Regarding an annual Dam Safety Program report on the website, a summary of the current annual report will be posted on the web site by May 31 each year.

How the actions taken will Improve Dam Safety in BC:

Under the *Water Act*, dam owners are responsible for the safety of their dams and liable for any damage caused by the failure of their works. Educating dam owners about maintaining, inspecting and safely operating their dams is the first line of defence in preventing dam failures. Linking dam owners with provincial and local government emergency response officials brings dam owners into the BC Emergency Response Management System (BCERMS).

FOLLOW-UP REQUIRED

- Deliver Dam Inspection & Maintenance Workshops through the WSABC and other associations. Confirm that these associations are able to issue Continuing Education credits to attendees as a mechanism of encouraging participation in the workshops. Determine which associations can cost share to reduce the cost to the Water Management Branch.
- Arrange for short educational presentations to be delivered by Regional Dam Safety Officers to ranchers at their local meetings.
- Revise the 1998 “Inspection and Maintenance of Dams” binder. Mail out the binder with the new Dam Safety Regulation package (see response to Recommendation #7 if possible).
- These activities require staff and budget and will be prioritized within the Dam Safety Program and Ministry annual business planning process.

BUDGET & RESOURCE REQUIREMENTS

- Additional workshops and educational presentations will be added when new staff increase the capacity of the program. Consideration should be given to establishing an annual fund to hire contractors to coordinate and deliver educational programs for the Water Management Branch. This could include educational programs on both dike and flood safety. Costs are not known at this time but are scalable to as much as \$30,000 per year.
- New Inspection & Maintenance Binders distributed to all dam owners will cost approximately \$20,000 and will require about one FTE for one month.

RISKS or OUTSTANDING ISSUES

- Expanding education and awareness initiatives with dam owners will require an increase in budget and staff in the Dam Safety Program.

ADDITIONAL RECOMMENDATIONS

- None

APPENDIX 2: 2010 DAM SAFETY PROGRAM REVIEW

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2010 Dam Safety Program Review

DELIVERABLE: Ministry of Environment Review of the Provincial Dam Safety Program

STATUS

In a July 14, 2010 [News Release](#) the Province committed to a review of the Provincial Dam Safety Program. The last comprehensive review of the Dam Safety Program was completed in 1996 by an external management consultant (Semmens and Adams) in response to a significant dam failure (Cannon Creek) in 1995. The 2010 Dam Safety Program Review was conducted by Ministry Of Environment staff to assess the effectiveness of changes made as a result of the 1996 report and to identify any additional improvements that could be undertaken.

How the actions taken will Improve Dam Safety in BC

The recommendations of the 2010 Dam Safety Program Review focus on four aspects: placing a higher priority and increasing Ministry resources associated with dam safety activities; some minor updates to the Dam Safety Program; and a review of the provincial approach to regulation of a variety of water retaining structures. Refocusing priorities and adding additional resources to the program will result in a greater level of regulation and oversight through increased audits of the dam owners and a greater level of follow-up of noncompliance issues. In addition, a systematic evaluation of all Ministry owned dams will lead to a greater level of inspection, physical upgrades or removal if warranted.

Some program updates will include an updated Dam Safety Regulation and improved inventory and database of dams. This will result in greater attention to dams as a result of increased inspections and reviews by dam owners along with greater tracking and reporting of these requirements by ministry staff.

FOLLOW-UP REQUIRED

Several of the follow-up items from the 2010 Dam Safety Program Review are captured by the Ministry response to the recommendations of the Deputy Solicitor General, including an updated Dam Safety Regulation, an improved registry of dams and improved regulation of other water-related structures. These are detailed in other sections of this report.

Additional staff and operational budget will be assigned to the Provincial Dam Safety Program to increase audits, improve data management and provide for follow-up of outstanding issue dam safety issues.

A list of 52 dams owned and operated by the Ministry of Environment has been forwarded to each individual agency with the Ministry responsible for their operation. A business case review of each structure will be undertaken to ensure that adequate operational budgets are in place. Where warranted, a capital budget for removal or upgrading of these structures will be developed and added to

the annual Ministry budget process for consideration. In addition, staff from the Dam Safety Program will conduct audits of each dam owned and operated by the Ministry of Environment over the next year.

BUDGET & RESOURCE REQUIREMENTS

An additional 4 full time equivalent (FTE) staff positions will be added to the dam safety program along with additional operational funding (\$60K).

Additional operational or capital budget requirements may be identified as a result of the audit or business case review of Ministry owned dams. These financial requirements will be brought forward as part of the annual Ministry budget process.

RISKS or OUTSTANDING ISSUES

- Maintaining the Dam Safety Program as a priority in the future with other competing Ministry priorities will continue to be a challenge.
- Some of the capital requirements for Ministry owned dams could be substantial, particularly if removal of the structure is proposed.
- Increased inspection and compliance may result in increased costs for local dam owners which may be difficult to absorb, particularly by small local government or agricultural users.

ADDITIONAL RECOMMENDATIONS

- None



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Memorandum

Ministry of Environment

Water Management Branch

Date: September 22, 2010

To: Doug Konkin
Deputy Minister
Ministry of Environment

Re: Review of the Provincial Dam Safety Program

As requested, staff from the Ministry of Environment have conducted an internal review of the Dam Safety Program. I am writing to convey this report as well as provide you with my observations and recommendations for improving the program.

Background

BC is one of four provinces with a formalized dam safety program which provides oversight to nearly 2000 dams in the Province including some of the largest structures Canada. In a province with very diverse geologic, hydrologic and seismic conditions along with a variety of dam owners and operators, regulation of these structures can pose significant challenges.

In the late 1990's, in response to a significant dam failure a program review by Semmens and Adams and restructuring of the Dam Safety Program was undertaken. A copy of the Semmens and Adams report along with some of the details of the new program is contained in the attached material. The reader is encouraged to review the findings of this report, particularly the executive summary which provides a good overview of the issues. This current review will not attempt to reproduce this information, but will build on the previous recommendations and identify areas where the program can be further improved.

By the early 2000's the recommendations of this review were fully implemented and this is essentially the program that we are delivering today. The new dam safety program is "results-based" with considerable reliance on professionals and dam owners to maintain the safety of these structures. Fundamental to this new program was the shift in Ministry staff role from inspection functions to audit and education functions. The primary responsibility for the safety and operation of these structures rests with the dam owners.

Under this new approach it is anticipated that there will be a certain number of negative results, which in the field of dam safety are represented by dam failures or incidents. On average we have been experiencing several incidents and at least one dam failure in British Columbia annually. While it is possible to further reduce the number of these incidents and failures

through some of the recommendations outlined below, it is not possible to completely eliminate them. In fact if we wish to reduce these incidents and failures to near zero, we may need to move towards a more prescriptive model, and even then they will not entirely be eliminated. The Semmens and Adams report states that “Dams can and do fail”, as a compelling and factual reality.

In general I believe that we have a good, effective, modern dam safety program, however it could be improved through a modest increase in resources along with a refocusing of efforts as described below.

Observations and Recommendations

1. Priority

Many of the provincial Dam Safety Officers do not work full time on dam safety issues and other competing priorities such as water licensing, IPPs and flood safety issues take time away from dam safety activities. Ensuring dam safety activities are a priority for these individuals is essential for an effective dam safety program.

The Province and specifically the Ministry of Environment currently owns and operate a number of dams. Some of these structures are not fully compliant with the Dam Safety Regulations with respect to inspection, operation and review. Compliance with the Regulations must be a priority for all provincial staff.

Many of these provincial dams have been constructed or acquired over the years for flood control, water supply or habitat enhancement purposes; however inspection and maintenance resources to manage these structures are not always available. Some dams have been transferred or defaulted to the Province and continue to be maintained on an ad hoc basis. The suite of dams owned by the Province should be reviewed; a business case for their operation or removal should be developed, along with a plan for removal of those structures that are no longer required.

2. Resources

The Dam Safety Program was transformed to a results-based model in part due to the excessive resources required to maintain the existing approach. After the transformation the Ministry assigned approximately 8.5 full-time equivalents (FTEs) to this program, however this number has fallen to 5.5 in recent years. This has resulted in staff being slightly behind on scheduled audits and left little time for follow-up of outstanding issues identified during these audits. Additional staff resources would allow for more frequent audits, follow-up on problem dams and an application of the Dam Safety Program as originally designed.

3. Program Design

While the Provincial Dam Safety Program is a good model there are a number of minor improvements that could be made. These include a change to the Dam Safety Regulation which would bring the classification system in line with the 2007 Canadian Dam Association

Guidelines, along with the minor updates of the provincial dam database. In addition, an internal review of consequence classifications for all dams in BC may be warranted, however this is a highly technical, labour intensive process. Although the program currently has an 87% return of annual compliance reports a review of the regulatory framework in regard to improving that number and general efficiency and effectiveness should be undertaken.

4. Other Related Risks

While the recent failure of the dam near Oliver has brought attention to the dam safety program there are several other water related risks that could attract future attention from a similar failure.

Mine tailing dams are not regulated by the provincial Dam Safety Program, even though they are similar in nature. An MOU exists between the Ministry of Environment (MOE) and the Ministry of Energy Mines and Petroleum Resources (MEMPR) which assigns MEMPR as the lead with respect to these structures. The public is not likely to make the distinction between one of these structures and a regulated dam, so a consistent approach to risk ranking and mitigation could be advantageous. MOE staff will explore these issues with MEMPR staff.

The majority of the **dikes** in the province, both those with an identified owner and orphan structures (provincial) do not meet current provincial standards. In many cases regular inspection and maintenance of these structures is not being undertaken by the owners. It is therefore very possible that failures of these structures could occur during flood events, below design levels. The current provincial Flood Protection Program is addressing some of the infrastructure upgrades associated with these structures; however a considerable backlog in inspection, maintenance and capital investment exists.

Associated with the 44,000 water licenses in the province are **authorized works**, most of which are not covered by the Dam Safety Regulations. A very small portion of these works do include structures which could pose a risk to public safety. These include high pressure water conveyance structures such as pipelines and penstocks along with other works associated with the hydroelectric industry. IPPs, most of which are run of river include many works not associated with a dam. As such they are not subject to the normal audit programs. Due to the limited number of these types of works and a high standard of design the overall risk is generally low, however it may be prudent to identify any higher consequence structures for additional oversight similar to the Dam Safety Program.

Conclusions

The model and tools employed by the Provincial Dam Safety Program are appropriate; however the effectiveness could be significantly improved with some relatively minor resource and program enhancements as outlined above. There are some related hazards associated with other water control structures which could also be reduced by a similar review.

Glen Davidson, P.Eng.
Comptroller of Water Rights
Ministry of Environment

Report on the BC Dam Safety Program 1967 to 2010

Introduction:

This report will describe the development of the BC Dam Safety Program from 1967 until the present day. The report was commissioned as a result of the events that occurred near Oliver BC on June 13, 2010 when the failure of a small dam apparently triggered a destructive debris torrent in the Testalinden Creek adjacent to the Okanagan River.

History of Dam Failures in British Columbia:

Despite the large number of dams in BC, there have been only two known fatalities as a result of dam failures. The first occurred in 1912 in the Vancouver Island port community of Union Bay. The Langley Lake Dam, which was poorly designed, collapsed during a winter rainstorm causing extensive damage to part of the town and the coal loading facility. Due to some advanced warning, the densely populated lower creek area was quickly evacuated, but one person died in the flood. During the 1948 spring flooding, a placer miner went missing following the failure of the Devick Lake Dam 30 kilometres north east of Kamloops. The body was never recovered and he was presumed drowned by the dam failure inundation. The main CN rail line was washed out on the North Thompson River, and considerable damage was done in the Heffley Creek area.

In the last 30 years, on average, there has been one recorded dam failure per year. Most of these failed dams have been small dams which caused minor damage which was sometimes reported in local media. The Cannon Creek Dam breach, in May 1995, was the most damaging failure in that time period (until the events near Oliver, June 13, 2010) and the impact on the Dam Safety Program was far reaching. This report will describe the development of the BC Dam Safety Program before the Cannon Creek Dam failure and after, and will explain how this near disaster was the catalyst for change. The report will outline the findings of the formal review of the provincial Dam Safety Program, conducted in 1996, and then focus on how the program evolved after that.

Dam Safety Program History

Prior to the establishment of the current provincial dam safety program in 1967, the safety of dams was regulated by Regional Engineers on an ad hoc basis. A number of dams failed during the flood season of 1948 causing wide spread damage and one fatality. An index of dams for the Interior of BC was created following the 1948 floods and dam inspections by Regional Engineers and technical staff were carried out. The dam building boom of the 1960's created the need for a formal Dam Safety Program to review and authorize the construction of major projects such as the WAC Bennett and the Mica Dams and to inspect all major dams. The Provincial Dam Safety Program was established in Victoria in 1967 by the Comptroller of Water Rights to ensure that Major Dams in the province were designed, constructed, operated and maintained to acceptable standards for public safety. Major Dams were initially defined as meeting the size criteria for ICOLD⁴ dams, but soon the dam height definition was dropped from 15m (50 feet) to 9m (30 feet). Smaller dams continued to be inspected by Water Rights staff in some regions under the Regional Engineers. The regional offices began to turn to the Dam Safety Program in Victoria for assistance with plans review and approval. Additional staff were added in Victoria in 1971 and 1975 to undertake dam inspections as well as specialized work such as underwater inspections and dam

⁴ International Commission on Large Dams

instrumentation. Victoria Dam Inspectors began a pilot project on Vancouver Island in 1976 to complete an inventory of all dams in that region under 9 meters. Work on this inventory was soon expanded to the rest of the province and Dam Inspection Officers were established in all regions over the following years.

Dam Inspection Program – Policy and Procedures Manual 1986

In 1986 the Provincial Dam Safety Program was formalized under the Comptroller of Water Rights in a Policy & Procedures Manual. The following policy statement was developed at that time and the basic concept is still in effect today:

The owner of a dam is responsible for the safety of the dam and related structures. This responsibility extends to and includes ensuring the structural integrity, safe operation and adequate maintenance of these works.

The Comptroller of Water Rights shall co-ordinate a provincial Dam Safety-Inspection Program to ensure that dam owners meet these responsibilities.

The Comptroller and Regional Water Managers shall be respectively responsible for the administration of the Victoria and Regional components of the program, which shall be mutually supportive.

The 1986 policy & procedures manual is a comprehensive document addressing regulatory inspection schedules and consequence classifications as well as records filing and staff safety. The following are a list of some of the more important procedures in the manual. Most of these procedures were modified, as described, following the formal program review that was commissioned after the Cannon Creek Dam failure in May, 1995.

1. Processing the Water Licence: A water licence is issued following an investigation of the availability of water (for the use specified in the licence application) and consideration of prior rights by others on the stream. The person holding the water Licence will become the dam owner. The procedures explained in detail how to engage the dam owner at this application stage and how the Victoria & regional dam safety staff would review the proposed design. It did not, however, address the more important issue of the final approval of the dam design which is typically given as a “Leave to Commence Construction” (LCC) letter under a clause in the water licence. In 1998, *Plan Submission Guidelines* were produced and distributed to applicants to ensure that the prospective dam owner understood the submission, review and approval process. These guidelines have been updated and now include rehabilitation of existing dams.
2. Dam Failure Consequence Classification: BC was one of the first provinces in Canada to specify a consequence classification for dams. The “Disaster Potential Classification” chart had 3 classifications, A (High), B (Moderate) and C (Low) based on the BUREC model. This system had been in place for some years prior to 1986 and classification levels were attributed to the dams by a wide range of staff using limited information. In retrospect, the Cannon Creek Dam should not have been rated as C (Low), but, the impact of a dam failure is difficult to determine without doing a computer “dam break” analysis. Other potential consequences of a dam failure, such as triggering a debris torrent in the creek bed below, would not be accounted for in the dam break analysis. Determining consequence classification accurately requires the proper hydrotechnical tools and considerable experience.

3. Dam Inspection Schedule: The procedures described in detail how the annual inspection schedules would be prepared for the Victoria and regional dam safety staff. Inspection schedules were to be determined using the table below. Inspection frequency for dams under construction and under special circumstances was to be done “as necessary”. Considering the number of dams and the limited number of staff, it soon became apparent that doing effective dam inspections on this schedule was not feasible.

Commissioning	A	Twice yearly
	B	Annually
	C	2 years
Operational	A	1 Year
	B	2 Years
	C	4 Years

4. Dam Inspections: The inspection process was described as having three phases; pre-field work, on-site inspection and the inspection report. A generic Dam Inspection Report checklist was provided for use on site and as a template for the final report for smaller dams. The checklist ends with the following quote from Section 18 of the provincial Water Act.

Note to Licensee: Section 18(1) of the *Water Act* states, “Every licensee and person who has obtained approval under Section 7 shall exercise reasonable care to avoid damage to any land, works, trees, or other property, and shall make full compensation to the owners for any damage or loss resulting from the construction, maintenance, use or operation of the licensee’s works.

This quote from Section 18 was included in the inspection report that the Dam Safety Officer sent to the owners of the Cannon Creek Dam in 1992. This quote did not adequately explain to the dam owner that they were responsible for undertaking regular dam inspections; in fact they believed that the government was doing their inspections for them. This was reinforced by the fact that the dam was located on crown land.

5. Dam Inspection Reports: Guidance in this section included how to indicate the urgency of any remedial action required and the type of escalating enforcement required. The following was the recommendation regarding the responsibility of the dam owner:

...ensure that the text (of the inspection report) reflects the fact that the responsibility for the dam and its operation rests solely with the owner and that the subject dam inspection is a regulatory function of the Water Management Branch implying no shared responsibility.

A sample inspection report cover letter was provided in the manual which refers to the inspection report as a “regulatory dam safety inspection”, but nowhere does it mention that annual inspections and regular surveillance are the responsibility of the dam owner. The requirement that dam owners inspect their dams was not made clear to dam owners until the Dam Safety Regulation was proclaimed in February 2000.

6. Operation & Maintenance Manuals: Guidelines for the preparation of Operation & Maintenance Manuals, which included Emergency Plans, were distributed to the owners of all Major dams in 1984. This was the first in a series of dam owner guidelines that were planned at that time. The failure of the Cannon Creek Dam was the catalyst that led to improve communication with dam owners.

It is important to note that the Policy & Procedures manual was an internal document and dam owner requirements were not distributed in a systematic or effective manner to the dam owners. The staff and management in the Dam Safety Program at the time recognized the importance of the difference between their regulator inspections and the inspection and surveillance that was expected of the dam owner. The importance of dam owner inspections was expressed frequently to dam owners on site as well as during communication with water supply associations and other stakeholders. However, as the example of the Cannon Creek Dam will demonstrate, this was not good enough.

Cannon Creek Dam Failure – May 27, 1995

In May 1995, a 6 metre high earth-filled irrigation dam failed causing approximately half a million dollars damage. The sudden release of storage killed 48 head of cattle, destroyed 1.5 km of a public road, damaged 100 acres of hay field and introduced 700,000 cubic metres of material into the Quesnel River. The 3 residents of the ranch put their lives in danger by trying to rescue their cattle and by trying to escape through the flood flow. A dramatic story of their escape was headline news in the Quesnel-Cariboo Observer newspaper. The story was used to produce an educational video by the Victoria Dam Safety staff. The video is still in active use today as an education tool for the “Inspection and Maintenance of Dams” workshop conducted twice annually in conjunction with the BCWWA.

Report on the Cannon Creek Dam Failure, June 7, 1995

It should be noted that the regional boundaries for administration of the *Water Act* had recently changed; the dam had last been inspected by the Dam Safety Officer, Northern Region (DSO-NR) in 1992. At that time, Regional DSOs were still aiming to inspect dams based on the schedule in the Policies & Procedures Manual. The Cannon Creek Dam was classified as a low consequence dam and as such was scheduled for inspection every 4 years. An inspection report, with recommendations for improved maintenance, was written in 1992 and sent to the dam owner. The format of the report followed that described in the Policy and Procedures Manual (see page 3.) The Dam Safety Officer for the Cariboo Region investigated the site following the failure and interviewed the dam owners and others. The failure mechanism is described in his report in detail. In summary, the outlet sluice developed a hole near the lower, center of the dam and the dam failed by internal erosion and embankment collapse. The following are some bullets from his excellent report:

- “The hazard classification of this structure is Low/”C”. In review of this dam failure it may appear that the classification would have been more appropriate as as Moderate/”B”. This would have resulted in more extensive follow-up, on compliance or enforcement matters and a continuation of regulatory inspections. However, this could be said of any of the “upper” C category dams.”
- “The licensees were aware that there was internal erosion of the embankment taking place. While the licensee did make attempts to solve the problem they were having with the dam on their own, they did not attempt to contact an expert or someone with extensive experience with dams. The licensees were sent reports and letters from the (DSO-NR) yet neither he or myself, or an engineering or construction firm were contacted.”
- “Had the licensees taken action immediately to draw down the reservoir and an attempt made to control the piping, failure of the dam may have been averted.”
- “A water license (CWL 44213, 130 acre feet storage) was issued in 1975 which does not contain a clause requiring submission of plans prior to construction.” This is a serious omission and one which likely lead to the dam owner building the dam himself without any engineering input.

Provincial Emergency Program Report on Disaster Financial Assistance Application (DFA) for Owners

The Provincial Emergency Program (PEP) undertook an investigation of the flood inundation damage to determine if the ranch owner's application for DFA was valid. DFA is not paid to victims if it is determined that they were at fault. PEP determined that 50% of the DFA would be paid to the ranchers because PEP accepted the owner's assertion that the provincial government had not followed up adequately on their "inspection". This is despite the fact that under the *Water Act*, licensees are responsible for their works and liable for any damage caused.

"An Evaluation of the Dam Safety Program" Report 1996

Senior officials from the Ministry of Environment decided that a review of the provincial dam safety program was in order. The management consultant company, Semmens and Adams (S&A) was hired to undertake a comprehensive review and to recommend a renewed program model. S&A conducted the review by interviewing front line staff in regions and headquarters, senior management, 45 dam owners, engineering consultants, four neighbouring jurisdictions and conducted an extensive file review.

The S&A report recommended that Victoria continue to regulate Major dams and the regional offices regulate the Regional dams. In addition, Victoria would be responsible for specific additional roles, i.e., leadership, direction and authority; evaluate and report on the overall program and provide services to regions. This has evolved into the function referred to as "Program Management" under the current Dam Safety Program. (see page X).

The S&A report recommended that the renewed program should move in three directions. Under these 3 headings the report contains over fifty sub-recommendations. Given the limitations of this report, the recommendations are summarized under the three directions as follows:

1. Re-Focus on the Dam Owner: This is summarized by the statement, "The main focus of the program would be on the dam owners, enhancing their appreciation of their obligations and liabilities and ensuring that they have a "Dam Safety Program" to help them effectively maintain and operate their dams". S&A recommended that the focus on potential dam owners should be with clear information on the liability and responsibility of dam ownership before they decide to build a dam. S&A recommended new regulations and guidelines to define the requirements for dam owners to inspect their dams and to operate and maintain them to current acceptable standards. Also under re-focus on the dam owner, S&A recommended "audits of owner compliance", owner education on dam safety and legal responsibilities and regular reporting by owners.
2. Inject More Rigour, Consistency and Accountability: A series of steps was recommended as follows: clear accountability for the program, visible support and direction from management, resolve non-compliance issues related to ministry owned dams, use available enforcement tools and compliance tools, use scarce resources more effectively, remove abandoned dams and learn from dam failures.
3. Provide Needed Tools to Staff: For staff S&A recommended: the continuation of annual dam safety seminars for DSOs, an integrated database and filing system including a risk based

classification system, regulation and guidelines to assist the DSOs and a clear Memorandum of Understanding with Mines Branch regarding tailings dams.

The S&A report notes that the Canadian Dam Safety Association (now CDA - Canadian Dam Association) “represents a source of credible standards for dam safety. These standards should be considered when designing the Program.” The CDA published their first Dam Safety Guidelines in 1995 and these guidelines soon became the accepted “best practice” for dam owners in BC and Canada. The CDA Guidelines are currently a critical tool for both the dam owner and the regulator.

The S&A report lists a number of “factual realities” which are still relevant today (with the exception of bullet number 3). The list is under subsection 1.5 “Several Compelling and Factual Realities Drive Our Observations and Recommendations” on page 4 of the S&A report.

Note: Two additional events during the summer of 1996 had an impact on the dam safety program due to the media attention focused on dam incidents. The WAC Bennett Dam sinkhole incident in June resulted in the Comptroller of Water Rights issuing an ORDER under the *Water Act* for the owner to begin to immediately begin reservoir drawdown procedures. The dam continues to operate under a *Water Act* ORDER and currently has one of the most sophisticated surveillance programs of any dam in the world. The second event was the severe flooding of the Saguenay's tributary rivers from July 18 to 21, 1996. The floods devastated the region in one of Canada's costliest natural disasters, and brought dam safety to the national attention. A significant number of dams were damaged or destroyed as a result of the flood although no deaths were attributed to directly to any dam failures.

Dam Safety Renewal 1996

Prior to the completion of the S&A report the renewal of the dam safety program was underway. Priorities were to enact the Dam Safety Regulation, replace the “inspection” procedure with a risk-based approach, identify all ministry owned dams and safeguard any abandoned dams. Ministry owned dams and abandoned dams were addressed with a combination of removal, securing acceptable ownership or reducing the risk to an acceptable level. Many of the recommendations proposed by S&A were already recognized by the people working in the Dam Safety Program. In fact, S&A spent many days interviewing staff and analysing their innovative ideas for creating an improved program. This created enthusiastic support from staff for change and was instrumental in the successful implementation of the Dam Safety Renewal Project from 1996 to 2001.

Dam Safety Regulation

A draft Dam Safety Regulation was originally started in 1990 to describe and define the responsibilities and liability of Dam Owners under the provincial *Water Act*. A key priority of dam safety renewal was to enact the Dam Safety Regulation. Following extensive research, consultation with regions and our solicitors and full public consultation, the regulation was proclaimed in February 2000.

It is important to note that as a result of consultation with the solicitors and the public prior to the enactment of the Dam Safety Regulation, some of the recommendations in the S&A report were not viable. Two examples are: transferring the regulation of dams on mine sites to the Mines Branch, and, the removal of all abandoned dams, many of which had valid water rights held by licensees.

The Dam Safety Regulation is considered to be a “non-prescriptive” regulation because it does not specify how dams are to be designed or built, but depends on other guidelines and best practice for those details. A number of guidelines, checklists and templates have been prepared by the Dam Safety Program since 1998 to assist dam owners, see “Current Dam Safety Program” below.

The requirements under the Regulation are based on the complexity of the dam and the potential downstream consequences (see Schedule 1 of the Regulation). Dam owners must satisfy all ongoing requirements and may also need to meet special and/or additional requirements:

1. Ongoing Requirements

- safe day to day operation and maintenance of the dam,
- regular inspections of the dam (i.e., site surveillance, formal inspections, recording instrumentation data, and testing mechanical components),
- reviewing and updating the operation, maintenance and surveillance plan,
- reviewing and updating the emergency preparedness plan (high and very high consequence dams only),
- performing dam safety reviews (high and very high consequence dams only), and
- reporting all significant findings resulting from inspections and/or dam safety reviews to the Dam Safety Officer.

2. Special Requirements

- obtain Water Stewardship Division authorization when alternations, improvements or replacements to all or any part of their dam are considered,
- notify the Dam Safety Officer and get authorization prior to the removal, decommissioning or abandoning their dam, or
- operate their dam in a manner, and initiate remedial actions, that will safeguard the public and dam when hazardous conditions at the dam are found.

3. Additional Requirements - if required by Water Stewardship Division:

- install any instrumentation necessary to adequately monitor the performance of a dam,
- obtain an expert’s opinion on the design, construction and analysis of the dam,
- obtain the opinion of an appropriate specialist such as hydraulic, hydrological, geological, geotechnical, mechanical or structural engineer or related professional on various questions,
- submit additional information, including recorded data, on the dam, reservoir, downstream area, or watershed upstream of the dam.

Risk Based Classification and Monitoring System 1998

In 1998 a Risk Based Classification and Monitoring procedure replaced 2 sections of the 1986 procedures, “Disaster Potential Classification” and the “Dam Inspection Schedule”. The consequence classification was revised to reflect the Canadian Dam Association classification table in the CDA Guidelines, first published in 1995. This classification table from the 1998 procedure became Schedule 1 of the Dam Safety Regulation.

The monitoring section provides procedures and tools to assist the DSO to qualify the risk posed by each dam and each year to develop an annual work plan to monitor all high risk dams. The risk levels, numbering 1 to 5, are determined using a combination of the Failure Consequence Rating and the Failure Probability Rating. This risk based monitoring system is a valuable tool for determining overall dam safety, but did not provide a good annual measure of performance and accountability by the DSOs. The audit program was implemented in 2003, following the completion of the Compliance Strategy in 2002, to address this concern.

Compliance Strategy 2002

The Compliance Strategy document outlines the key strategies that became the compliance portion of the Dam Safety Program. The four components are described as: education of dam owners, tracking dams and owners with a database, surveying owners for compliance and a formal auditing program. Please see the description of the current Dam Safety Program below.

Audit Program 2003

Dam audits are to be undertaken every 5 years for High and Very High Consequence dams and every 10 years for Low Consequence dams. Very Low (VL) Consequence Classification dams are not included in the audit program at this time

Under the audit program the DSO creates an annual audit schedule as part of his/her personal work plan. The DSO completes a “Dam Audit Check Sheet” and will provide a copy to the owner on site. The DSO may also complete a dam inspection form **with the owner** while on site as part of the education process. Audit information will be entered into the dam database and the dam file upon return to the office. Consequence classification, probability of failure and risk level will be reassessed and entered into the dam database. If a hazardous condition is uncovered during an audit, the Dam Safety Officer will attend to the situation immediately.

The audit schedule was originally devised by assuming that a DSO would commit 30% of his/her available time as a DSO to the actual audit. The remained of his/her time would be spent doing follow-up compliance, plans review and approval, data entry and responding to incidents and emergencies. In 2003 there were 6 Regional DSOs, but the amount of time devoted to dam safety amounted to 2.5 FTEs. The 3 Victoria DSOs account for 3 FTEs for a total of 5.5 FTEs in the Dam Safety Program in 2003. Despite changes in organizational structure, regional boundaries, and retirements, the number of FTEs in the Dam Safety Program is currently similar.

Canadian Dam Association Guidelines 2007

The CDA published guidelines in 1995 and a revised version in 1999. In 2003 the CDA began soliciting input and suggestions from all members through committees and workshops. The guidelines were re-written and divided into two sections, Principles and Technical Bulletins. One important revision was to the Dam Classification Table. The 4 category consequence classification system, defined in the 1995 and 1999 versions, was replaced with 5 consequence classifications in the 2007 guidelines. As noted previously, the consequence classification system in the Dam Safety Regulation has 4 consequence classifications, similar to the previous CDA guidelines. The Dam Safety Section has prepared an Interim Consequence Classification Policy that provides guidance to dam owners and engineers on how the 2 classification systems are related and can be used coincidentally.

Current BC Dam Safety Program - 2010

A number of key deliverables have significantly improved the program since the Dam Safety Renewal Project was initiated. A number of guidelines for dam owners are available on the web site including the 1998 *Inspection & Maintenance of Dams* and the *Dam Safety Review Guidelines* completed this year. The *Plan Submission Guidelines* address the first recommendation of the S&A report by providing prospective dam owners with the information they require to understand the responsibilities and liability of dam ownership as well as the very stringent requirements for dam design and construction. The process for plans review and approval by the Water Stewardship Division are outlined in this document. The outline of the current Dam Safety Program is shown below:

1. Dam Owner Compliance	
• Dam Auditing	H & VH consequence dams every 5 years – 288 dams Low consequence dams every 10 years – 497 dams
• Education & Awareness	Dam Owner Workshops with BCWWA Dam Safety Guidelines Website Information
• Compliance Mail-Out	Annual compliance mail-out to all H & VH dam owners
• Dam Registry	Dam Registry for internal use – dam data & tracking iMap & Google Earth – public dam data geo-referenced
2. Plans Review & Approval	Plan Submission Guidelines for owners and DSOs • Dam Removal Projects • Dam Rehabilitation Projects • New Dam Projects
3. Program Management - Headquarters	Annual Report on Program Performance & Achievements Produce Guidelines, Templates & Checksheets - website Annual Dam Safety Seminar – with Flood Safety biannually DSO Training – 4 day training and ongoing support
4. Emergency Planning & Response	Dam Emergency Response Plan – EPA requirement

Summary of Numbers of Regulated Dams in BC by Consequence Classifications as of May 2010

Very High	31		
High	257		
Low	497		
Very Low	1200	Total	1,985

Challenges Facing the BC Dam Safety Program

1. One of the challenges facing any dam safety program is to create a regulatory process that encompasses both large dams and small dams in a consistent manner. When distributing scarce resources it is logical to concentrate resources on the regulation of higher consequence dam owners and high risk dams. It is much easier to get results when regulating the large dam owners with financial and technical resources. The difficulty is to achieve acceptable results from owners who don't have adequate resources.

2. Policies and Procedures – Water Stewardship Division Policies and Procedures have not been updated for some time. The new E-Licensing system offers a good opportunity to create modern “work flow management” procedures in stage 2 of the E-Licensing program.
3. Water Licensees who hold storage licences, and have not made beneficial use of the water by constructing their dam(s), should have their water licences cancelled if they do not have immediate plans to construct a dam. Those wanting to construct a dam should receive clear communication that they must abide by the “Plan Submission Guidelines” and receive the Leave to Commence Construction letter prior to construction. Verification of unconstructed dams could be made by a LIDAR mapping or other form of aerial reconnaissance. A MOF employee has offered his services to undertake an aerial photography review of dam sites using high resolution photos which might be able to confirm dam existence and location. This proposal has not yet been analyzed to determine the applicability to this project.
4. Dam Safety Officers with competing priorities: Most DSOs do Water Allocation work including adjudication of IPPs. Dam Safety is always an important task but rarely is it urgent such as the recent events near Oliver. In many regions, the combination of working on Dam Safety and IPPs is a good one that fits the job requirements well. But, many DSOs are also doing backlog reduction or water licence amendments as well.
5. Dam Registry (previously referred to as the Dam Database): Until May of 2010, the dam registry was tied to the old Water Licensing Information System (WLIS). This old system accounted for the extreme difficulty in inputting data. Tracking trends and performance was not possible with WLIS. There are many gaps in the data which need to be addressed.
6. In 2007, the CDA replaced the 4 category consequence classification system with 5 consequence classifications. The Dam Safety Section has prepared an Interim Consequence Classification Policy that provides guidance to dam owners and engineers on how the 2 classification systems are related and can be used coincidentally. The Dam Safety Regulation should be revised to align with the CDA classifications to avoid any confusion and provide clarity.
7. At present, only the owners of High and Very High Consequence dams receive an annual compliance mail-out. This annual project represents a significant effort each year on the part of the Victoria Dam Safety Section. The feasibility of including the Low Consequence Classification dams in the annual compliance mail-out should be assessed. This would be a significant increase in effort, including more than double the number of letters, verification of dam owner contacts and follow-up on non-compliance.
8. In April 2000, all known dam owners received a package of information introducing the Dam Safety Regulation. Copies of the binder, *Inspection and Maintenance of Dams Guidelines*, were included. The owners of Low and Very Low consequence classification dams have not officially received a follow-up reminder of their responsibilities under the Dam Safety Regulation. This would be a good time for another mass mail-out, similar to the one in 2000.
9. Downstream Development affecting Consequence Classifications: WSD no longer receives “referrals” of subdivision approvals and re-zoning application. This is a significant issue for the Flood Hazard Management Program as well. One way to address this would be to systematically review the consequence classifications of all Low & Very Low Consequence Classification dams in areas of known increases in downstream development. This would include the Okanagan corridor, Vancouver Island east side, Lower Fraser Valley and portions of the East Kootenay at a minimum. The first step would be to identify candidate dams, then to undertake computer modeling, i.e., “dam break” studies to define the potential inundation zones. Some DSOs are experienced modellers who specialize in small dam breaches, but there are not enough of them to do a large job such as this. Hydrology consultants would be needed.

On the plus side:

10. We are now able to use Google Earth to locate dams and geo-reference the data. Local approval officers will be able to see if there are dams upstream of new development proposals. They could require that the development applicant work with the dam owner to determine if the consequence classification would increase, and if so, the developer would pay for the dam upgrade, just as they pay for upgrades to sewer, water, roads and other infrastructure that would be impacted by their development.
11. Local Governments will now be able to see at a glance if there is a dam on a creek upstream from their communities which will allow them to add the dams to their Local Emergency Response Plans as required under the Emergency Program Act.

Conclusion:

The Cannon Creek Dam failure was a catalyst for the evolution of the BC Dam Safety Program. Many of the recommendations proposed by the management consultant company, Semmens & Adams were already recognized by the people working in the Dam Safety Program. One of the most important shifts was for the regulator to move fully away from any impression that the province was doing dam inspections for the dam owner. This is in fact a results based model that relies on the owner to meet the requirement of the Dam Safety Regulation. Most High & Very High Consequence dam owners are taking full responsibility for their own Dam Safety Program, including regular inspection and surveillance. More work is required to bring the owners of Low Consequence dams up to the same level of compliance.

An important principle of the program is to only request information from the dam owner that the regulator is able to absorb. For instance, many regulators require owners to submit full annual inspection reports, but are unable to absorb and analyse all the information. The idea of asking only for confirmation of completion, then auditing periodically for confirmation, is a practice which has merit as long as the program is staffed and resourced adequately.

Will Jolley, Section Head, Dam Safety
Water Stewardship Division
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